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BIBLIOGRAPHY OF EXTRATERRESTRIAL RADIO NOISE

SUPPLEMENT FOR 1952

by

Martha Stahr Carpenter

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INTRODUCTION

Two series of reports are being issued under the general title "Bibliography of Extraterrestrial Radio Noise." The first series, in which references are classified according to subject matter, contains abstracts of the published literature pertaining to radio noise of extraterrestrial origin. It is intended to be permanently useful. The second series consists of quarterly lists of references only, arranged alphabetically by author. Issued to provide such information with the minimum practicable delay, the reports of the second series are intended for temporary use only; they will ultimately be superseded by reports of the first series.

Publication of the first series has been interrupted for a period of several years but is being resumed with the issuance of the present report. In arrangement and scope of subject matter, as well as in most other respects, this "Supplement for 1952" is generally similar to its predecessors.*

As before, the references are grouped by subject matter into separate sections, the titles of which appear in the Table of Contents. Within each section the arrangement is alphabetical by author, or by title if no author is given. Each reference is assigned a composite number that consists of three parts, e. g., A2-52-07. The first part (A2) indicates the section and subsection, if any, in which the reference is listed, the second part (52) gives the year of publication, and the third part (07) is a serial number determined by the alphabetical arrangement. A given reference appears in one section only; at the end of each other section to which its content is particularly appropriate, it is referred to by number.

Occasional cross-references are made by number. A number whose middle part is 51 or less designates a reference appearing not in the present supplement but in one of the preceding reports of this series.

The titles of sections adopted for the present supplement differ slightly from those adopted previously. Papers discussing techniques either of making or of reducing observations were formerly listed in the section entitled "Miscellaneous" but are now brought together in a separate section entitled "Techniques." With the appearance, during

* "Bibliography of Extraterrestrial Radio Noise," issued on August 15, 1950, as Radio Astronomy Report No. 11 of the School of Electrical Engineering, Cornell University. "Supplement for 1950," issued on August 1, 1952, as Radio Astronomy Report No. 12 of the School of Electrical Engineering, Cornell University. "Supplement for 1951," issued on October 15, 1953, as Radio Astronomy Report No. 13 of the School of Electrical Engineering, Cornell University.

1952, of the first book dealing in large part with extraterrestrial radio noise, a new section listing references to book reviews has also been added. On the other hand, a previously included section on "Radiation from the Moon" is here omitted owing to a lack of material on this subject published during 1952. The section formerly entitled "Reviews" is here entitled "Surveys."

All references except those to book reviews are accompanied either by brief abstracts or, especially in the case of surveys, by statements indicating their scope. The large majority of the abstracts were prepared by the bibliographer, Martha Stahr Carpenter; they are signed with the initials (M.S.C.). Wherever appropriate, however, use has been made of abstracts accompanying the original publications, and in four cases of papers in the Russian language, for which translations were not available, other published abstracts have been used. The source of each abstract that was originally published elsewhere and is here reproduced by quotation, condensation, adaptation, or translation is acknowledged with a key letter designating the publication in which it appears, together with the signature, if any, accompanying it in that publication. The interpretation of the key letters follows:

(A) from abstract or summary accompanying the original publication
(N) from Astronomical News Letter
(P) from Physics Abstracts (Section A of Science Abstracts).

For example, the acknowledgement (P; F.Lachman) accompanies an abstract taken primarily from Physics Abstracts where it appears over the signature, F. Lachman. The initials M.S.C. have been included in the acknowledgement of any previously published abstract that has been added to or extensively modified by the bibliographer.

Every reference has been checked for accuracy against either the original publication or a reprint. The form employed in stating the references is in general consistent with that of the preceding reports of this series. For publications contained in periodicals, the general procedure is to specify consecutively the author, title of paper, name and series number or letter, if any, of journal, volume number, pages, and date. The issue number is usually not mentioned unless no date or month of publication is given. A key to the interpretation of the abbreviations used for the names of certain journals appears on page 4. Unless otherwise specified, the language in which a given paper is written is the same as that in which its title is given. Material supplied by the bibliographer is enclosed in brackets.

In references to publications dealing primarily with subjects outside the scope of this bibliography, the pages on which the pertinent material appears are specifically mentioned. Little or no attempt is made in such cases to abstract the contents of the remaining pages, regardless of their importance in other fields of investigation.

Each of Sections A1, B1, and C1 contains a "Supplementary Summary of Observed Wavelengths." The approximate wavelengths at which observations were reported during the year 1952 are given in each case. The organizations making the observations are specified, together with the numbers of the corresponding references in this supplement. Some of the information required for completeness has been supplied by the bibliographer. Observations previously described in references listed in earlier supplements are in general not mentioned.

In the author index, which begins on page 79, the references are designated by number. A number placed in parentheses indicates a secondary contribution, i.e., an article reporting a contribution of the given author but not listed in his name. The reports of meetings of the Royal Astronomical Society, for example, are indexed in this way under each of the participants.

The continued cooperation of colleagues, librarians, and friends, and especially of those authors and institutions that have sent reprints of their papers, is gratefully acknowledged. Abstracts of six papers published in the Russian language (those listed as A2-52-03, B2-52-04, B2-52-06, C2-52-04, E-52-08, and M-52-05) were prepared from translations provided by the Defence Scientific Information Service, Defence Research Board, Canada.

KEY TO ABBREVIATIONS OF TITLES OF JOURNALS

Ap. J.	Astrophysical Journal
Astron. Contrib. U. Man.	Astronomical Contributions of the University of Manchester
Aust. J. Phys.	Australian Journal of Physics
Aust. J. Sci. Res.	Australian Journal of Scientific Research
B. C. A. I. C.	Bulletin of the Central Astronomical Institute of Czechoslovakia
Comptes Rendus	Comptes Rendus des Séances de l'Académie des Sciences
Contrib. I. A. P.	Centre National de la Recherche Scientifique. Contributions de l'Institut d'Astrophysique de Paris
Dokl. Akad. Nauk S. S. S. R.	Doklady Akademii Nauk S. S. S. R.
J. Atmos. Terr. Phys.	Journal of Atmospheric and Terrestrial Physics
J. B. A. A.	Journal of the British Astronomical Association
J. Phys. Rad.	Journal de Physique et le Radium
J. R. A. S. C.	Journal of the Royal Astronomical Society of Canada
M. N.	Monthly Notices of the Royal Astronomical Society
Phil. Mag.	Philosophical Magazine, Seventh Series
Phys. Rev.	Physical Review, Second Series
Proc. I. E. E.	Proceedings of the Institution of Electrical Engineers
Proc. I. R. E.	Proceedings of the IRE (Institute of Radio Engineers)
Proc. Phys. Soc.	Proceedings of the Physical Society
Proc. Roy. Soc.	Proceedings of the Royal Society of London
Pub. A. S. P.	Publications of the Astronomical Society of the Pacific
Rep. Ion. Res. Japan	Report of Ionosphere Research in Japan (Science Council of Japan. Ionosphere Research Committee)
Tok. Astron. Obs. Reprints	Tokyo Astronomical Observatory Reprints

SECTION A

RADIATION FROM THE SUN

Part 1. Observations

RADIATION FROM THE SUN

SUPPLEMENTARY SUMMARY OF OBSERVED WAVELENGTHS*

Wave-length | Frequency (Mc./s.)

8.5 mm. — Naval Research Laboratory, U. S. A. .... Al-52-14, Al-52-17, Al-52-22, Al-52-23, M-[illegible]-07

10^4

3.1 cm.
3.2 cm.

- Naval Research Laboratory, U. S. A. .... Al-52-14, M-[illegible]-07
- C. S. I. R. O., Australia .... Al-[illegible]-24
- École Normale Supérieure, France .... Al-[illegible]-24, Al-[illegible]

8 cm.
9.2 cm.
9.4 cm.
10 cm.
10.6 cm.
10.7 cm.

- Nagoya University, Japan .... Al-52-15, Al-[illegible]-24
- Osaka City University, Japan .... Al-[illegible]-16, Al-[illegible]-24
- Cornell University, U. S. A. .... M-[illegible]-07
- C. S. I. R. O., Australia .... Al-[illegible]-24
- Tokyo Astronomical Observatory, Japan .... Al-[illegible], Al-[illegible]
- Naval Research Laboratory, U. S. A. .... Al-52-17, Al-[illegible], Al-[illegible]
- National Research Council, Canada .... Al-[illegible]-24

[illegible] cm.

- C. S. I. R. O., Australia .... A-[illegible]-06
- Cornell University, U. S. A. .... [illegible]

[illegible]

- C. S. I. R. O., Australia .... Al-[illegible]-24

10^3

50 cm.
[illegible] cm.
[illegible] cm.
[illegible] cm.

- C. S. I. R. O., Australia .... Al-[illegible]-24
- Institut d'Astrophysique, France .... Al-[illegible]-18, Al-52-19, Al-[illegible], Al-52-[illegible]
- Observatoire de Meudon, France .... Al-[illegible]-24
- National Bureau of Standards, U. S. A. .... Bl-[illegible]-14, [illegible]-52-[illegible]
- National Bureau of Standards, U. S. A. .... Al-[illegible]-14

1.2 m.
1.4 m.
1.5 m.
1.7 m.
1.8 m.
1.9 m.
2 m.
2.1 m.
2.4 m.
2.7 m.
3 m.
3.[illegible] m.
3.7 m.
4 m.
4.1 m.
4.8 m.
5 m.
6 m.
7.3 m.
7.5 m.
10 m.
12.5 m.

10^2

- Institut d'Astrophysique, France .... Al-52-18, Al-[illegible]-19, Al-52-[illegible], Al-[illegible]
- Observatoire de Meudon, France .... Al-[illegible]-19, Al-[illegible]
- Cavendish Laboratory, Great Britain .... M-52-03, M-[illegible], M-[illegible]
- Central Radio Wave Observatory, Japan .... M-[illegible]
- Commonwealth Observatory, Australia .... Al-[illegible]-24
- C. S. I. R. O., Australia .... Al-[illegible]-24
- Cornell University, U. S. A. .. Al-52-02, Al-52-09, Al-52-10, Al-52-11, Al-52-12, Al-52-14, Al-52-24, M-[illegible]-07
- Observing Station Nederhorst, Netherlands .... Al-[illegible]
- Tokyo Astronomical Observatory, Japan .... Al-[illegible]-16, Al-[illegible]-24, Al-[illegible]
- Cavendish Laboratory, Great Britain .... [illegible]-24
- École Normale Supérieure, France .... Al-[illegible]-03, Al-[illegible]-24, Al-[illegible]
- Institut de Recherches Scientifiques en Afrique Centrale, Belgian Congo .... [illegible]
- Institut des Hautes Études, French West Africa .... Al-[illegible], Al-[illegible]
- Laboratoire de Physique, [illegible], France .... [illegible]-4
- Observatoire Royal d'Uccle, Belgium .... [illegible]
- National Bureau of Standards, U. S. A. .... Al-[illegible]-14, M-[illegible]
- Radio Research Station, Great Britain .... Al-[illegible]
- Chalmers University of Technology, Sweden .... [illegible]
- Observing Station Nederhorst, Netherlands .... A[illegible]-24
- University of Manchester, Great Britain .... [illegible]
- National Bureau of Standards, U. S. A. .... B-[illegible]-4
- Solar Physics Observatory, India .... Al-[illegible]
- Tokyo Astronomical Observatory, Japan .... [illegible]
- C. S. I. R. O., Australia .... Al-[illegible], Al-[illegible], Al-[illegible]
- Cavendish Laboratory, Great Britain .... Al-[illegible]-16, Al-[illegible]-4, M-[illegible]
- University of Manchester, Great Britain .... M-[illegible]
- National Bureau of Standards, U. S. A. .... [illegible]-4
- Radio Research Station, Great Britain .... Al-[illegible]
- C. S. I. R. O., Australia .... [illegible]
- Tokyo Astronomical Observatory, Japan .... Al-[illegible]-16, A[illegible]
- Cornell University, U. S. A. .... [illegible]
- National Bureau of Standards, U. S. A. .... Al-[illegible]-14, B-[illegible]-14, [illegible]
- Radio Research Station, Great Britain .... Al-[illegible]
- Cavendish Laboratory, Great Britain .... M-[illegible], M-[illegible]
- Radio Research Station, Great Britain .... Al-[illegible]
- National Bureau of Standards, U. S. A. .... B[illegible]-24

* For explanation see page 4.

A1. RADIATION FROM THE SUN: Observations

A1-52-01 Aly, M. K. "Khartoum Expeditions for Total Solar Eclipse of February 25th, 1952: Report on the Meetings of Eclipse Astronomers," Observatory, 72, 63-72 (Apr., 1952). [Material pertaining to extra-terrestrial radio noise on pages 63-65.]

Four meetings of astronomers taking part in expeditions for observing the total solar eclipse of February 25, 1952, were held prior to the eclipse. The two observational programs dealing with radio astronomy were the subject of the first meeting. Dr. Hagen described two conflicting chromospheric models (low-temperature lower chromosphere with limb brightening versus high-temperature lower chromosphere with lower electron density than previously assumed) and emphasized the usefulness of precise observations of eclipse curves near centimeter wavelength for deciding between them. He outlined plans of the U. S. Naval Research Laboratory for making such observations at wavelengths of 8.5 millimeters and 9.4 centimeters. Dr. Laffineur presented the proposal of the Institut d'Astrophysique, Paris, for study of the characteristics of the solar corona by observations at wavelengths of 0.55 and 1.17 meters. (M.S.C.)

A1-52-02 "American Astronomers Report," Sky and Telescope, 11, 169-171 (May, 1952). ("Solar Flares and Solar 1.5-meter Radiation," 169-170; "Cornell Radio Interferometer," 170-171.)

Two papers presented at the eighty-sixth meeting of the American Astronomical Society are summarized. The first dealt with a detailed comparison, made by Helen W. Dodson, E. Ruth Hedeman, and Leif Owren, of solar radiation at a wavelength of 1.5 meters with photographic and visual observations [see A1-52-09]. The second paper contained a description of the radio interferometer at Cornell University and of its use, by Leif Owren and Helen W. Dodson, for identifying on spectroheliograms those active solar areas in which certain observed bursts of 1.5-meter solar radiation originated [see A1-52-12]. Outbursts that occurred on August 15, 1950, and April 2, 1951, coincided in position as well as in time with solar flares. (M.S.C.)

A1-52-03 Blum, Émile-Jacques, Denisse, Jean-François, and Steinberg, Jean-Louis. "Sur la Forme Ellipsoïdale du Soleil Observé en Ondes Métriques," Comptes Rendus, 234, 1597-1599 (Apr. 16, 1952).

Solar radiation at 169 Mc./s. was observed at a nearly central location during the annular eclipse of September 1, 1951, (see A1-51-04), and at Paris and Dakar during the eclipse of February 25, 1952, which was observed as partial at both places. Analysis of the curves of intensity plotted against time indicates that the coronal radiation from the equatorial regions of the sun is more important than that from the polar regions. To a first approximation the sun can be represented at this frequency as a greatly flattened

ellipsoid of nearly uniform brightness. [See also A1-52-04 and A1-52-08.] (M.S.C.)

A1-52-04 Blum, É. J., Denisse, J. F., and Steinberg, J. L. "Résultat des Observations d'une Éclipse Annulaire de Soleil Effectuées sur 169 Mc/s et 9350 Mc/s," Annales d'Astrophysique, 15, 184-198 (Apr.-June, 1952).

Measurements of solar radiation at wavelengths of 3.2 centimeters and 1.78 meters were made during the annular eclipse of September 1, 1951. The observing site was at Markala, French Sudan, a few kilometers from the line along which the eclipse was central. Equatorially mounted antennas, consisting of an array of sixteen half-wave dipoles for the shorter wavelength and a parabolic mirror 150 centimeters in diameter for the longer wavelength, were used with superheterodyne receivers. Meteorological conditions were good and the sun's radio radiation was undisturbed. The data are presented in the form of curves showing the variation of intensity with time. At the maximum of the eclipse, 16 percent of the radiation of the whole sun remained observable at 3.2 centimeters and 48 percent at 1.78 meters. The curve obtained at 3.2 centimeters is consistent with limb-brightening as predicted theoretically on the basis of a strong temperature gradient in the chromosphere. An asymmetry of the curve reveals a local source of radio emission that corresponded in size and position to a sunspot near the east limb; this source had an apparent temperature of at least 600,000°. The curve for 1.78 meters is symmetric and does not reveal the existence of this, or any other, local source. It corresponds to a solar brightness distribution that lacks circular symmetry, and it indicates that at this wavelength the sun's equatorial diameter substantially exceeds its polar diameter. (M.S.C.)

A1-52-05 Burgess, R. E., and Fowler, C. S. "Solar Activity and Ionospheric Effects," Wireless Engineer, 29, 46-50 (Feb., 1952).

Observations of ionospheric propagation conditions on long waves (191 kc./s.) and short waves (18.89 Mc./s.) during the period May 14 to November 30, 1948, were compared with observations of solar noise bursts at 30, 42, 73, and 155 Mc./s. and with the appearance of solar flares and sunspots. Examples of disturbances on the ionospheric and solar noise records are shown and data on correlations of the radio and flare phenomena are presented in tabular form. The noise bursts were observed by means of low-noise receivers used in conjunction with half-wave dipoles placed half a wavelength above the ground and lying perpendicular to the meridian. Commencements of ionospheric disturbances on short and long wavelengths coincided with each other and with the commencements of associated flares when these were observed, but differed by up to three minutes from times of onset of noise bursts. Eighty-six percent of the noise bursts occurred

without any accompanying ionospheric effect, whereas only a minority of the ionospheric disturbances occurred without noise bursts. This indicates a greater tendency for an active area of the sun to emit observable radio radiation than to emit ultra-violet radiation of sufficient intensity to disturb the ionosphere significantly. When a visible flare was accompanied by a noise burst, the times of onset were coincident to within a minute. (A; M.S.C.)

A1-52-06 Das, A. K. "Solar Noise Burst of 11 April 1952 and Associated Ionospheric and Magnetic Disturbances," Indian Journal of Meteorology and Geophysics, 3, 236, and figure on page 234, (July, 1952).

To illustrate types of data on solar-terrestrial relationships being obtained at the astrophysical observatory at Kodaikanal, records of an occurrence on April 11, 1952, are reproduced. They show that a magnetic crochet, bursts and enhanced emission of solar radio radiation at 100 Mc./s., and a partial ionospheric fade-out occurred between 0530 and 0615 U. T. Spectroheliographic and spectrohelioscopic observations were not in progress at the time but the occurrence of a synchronous flare can be inferred. (M.S.C.)

A1-52-07 Denisse, Jean-François. "Relation entre l'Activité Géomagnétique et l'Activité Radioélectrique Solaire," Annales de Géophysique, 8, 55-64 (Jan.-Mar., 1952).

A detailed account of an investigation, the results of which were previously summarized by Denisse, Steinberg, and Zisler [see A1-51-11], is presented. (M.S.C.)

A1-52-08 Denisse, J.-F., Blum, É. J., and Steinberg, J.-L. "Radio Observations of the Solar Eclipses of September 1, 1951, and February 25, 1952," Nature, 170, 191-192 (Aug. 2, 1952).

Observations of the sun at a wavelength of 3.2 centimeters during the annular eclipse of September 1, 1951, gave two types of evidence of limb brightening: (1) comparison with measurements by other observers at a total eclipse in 1950 (see A1-51-16) revealed that the disk fraction of area 8.6 percent covered at one eclipse but not the other gave rise to 10-12 percent of the total radiation, the theoretical figure being 12 percent if limb brightening is assumed; (2) the radiation was always less than that calculated for a uniformly bright disk of radius 1.07 times that of the sun, this radius being chosen to give the observed percentage remainder of the radiation at eclipse maximum. Characteristics of the solar radiation at a wavelength of 1.78 meters as observed during the same eclipse were: (1) the decrease began 16 minutes before first contact, indicating that the radio sun's apparent diameter was 1.35 times that of the optical sun; (2) at

the contact times the decrease amounted to 8.5 percent; (3) at maximum eclipse 48 percent of the total radiation remained. These results indicate that the equatorial apparent diameter of the radio sun at 1.78 meters considerably exceeds the polar apparent diameter; they are wholly confirmed by subsequent eclipse observations made at Marcoussis and at Dakar on February 25, 1952. A diagram illustrating a tentative model of the sun at 1.78-meter wavelength is presented. [See also A1-52-03 and A1-52-04.] (M.S.C.)

A1-52-09 Dodson, Helen W., Hedeman, E. Ruth, and Owren, Leif. "[Abstract:] Solar Flares and Associated 1.5 Meter Radiation," <u>Astronomical Journal</u>, 57, 9-10 (Apr., 1952).

The results of a detailed comparison of solar radiation at 1.5-meter wavelength with solar activity observed photographically and visually are reported. The radio phenomena accompanying 141 flares, which occurred between July 18, 1948, and December 31, 1950, were classified into the following descriptive categories: (1) major bursts including outbursts (22 cases), (2) minor bursts (22 cases), (3) micro bursts (6 cases), (4) series of bursts (32 cases), (5) small rise in base level (4 cases), (6) noise storms (26 cases), and (7) nulls (29 cases). Radio responses of types (1), (2), and (3) tend to occur at the very commencement of the rise of the optical flare. Those of type (4) precede the optical flare in time of onset, and those of types (5) and (6) often begin at or near the maximum of the flare and may become most intense just as the flare has faded completely. [See also A1-52-02 and A1-52-10.] (M.S.C.)

A1-52-10 Dodson, Helen W., Hedeman, E. Ruth, and Owren, Leif. "[Abstract:] Solar Flares and Associated 200-Mc/sec Radiation," <u>Proc. I. R. E.</u>, 40, 742 (June, 1952).

"Solar radio-frequency radiations on 200 Mc./s. have been compared with solar activity observed photographically and visually. The most clear-cut relationships have been found for radio emissions associated with solar flares. The present study covers 141 flares which occurred during the period August, 1948, to December, 1950. A solar flare is a complex phenomenon, and it is not certain which aspect of it is related to the associated radio event. The 200-megacycle events may be divided into seven categories: major bursts including outbursts, minor bursts, micro bursts, series of bursts, small rise in base level, short-duration noise storms, nulls. Eighty percent of the flares produced some form of enhancement in the 200-megacycle radiation. With but four significant exceptions, all of the flares for which no distinctive radio event occurred were relatively unimportant solar phenomena. For 20 flares for which the energy excess of the radio event has been measured there appears to

be a direct relationship between this and the importance of the flare. Comparisons of the times of onset of the flare and the radio event indicate that major, minor, and micro bursts occur at the very commencement of the optical rise. Series of bursts begin in a number of cases before the start of the optical flare; noise storms and base-level increases start at or near flare maximum. Such delayed events increase in intensity as the flare fades and often attain greatest intensity when the flare has faded completely." [See also A1-52-02 and A1-52-09.] (Reproduced in full)

A1-52-11 Dodson, Helen W., and McMath, Robert R. "The Limb Flare of May 8, 1951," Ap. J., 115, 78-81 (Jan., 1952).

Published data indicate that flares have been observed at the limb of the sun with elevations above the chromosphere of 8000-80,000 kilometers. Continuous records of the solar limb and disk secured on Hα spectroheliograms at the McMath-Hulbert Observatory show the outbreak and development of a number of these flare-like prominences. They range in form from relatively small cap-type prominences to the great flare prominence of May 8, 1951. This latter object rose to a height of 50,000 kilometers in less than 90 seconds. During this interval the Hα lines of the spectrum were 8-10 angstroms wide and showed large Doppler displacements. Throughout the remainder of the flare the change in height was negligible, and the Hα spectrum lines were 5-6 angstroms wide and symmetrical. This flare prominence was four times as bright as the undisturbed Hα disk, was accompanied by an increase in solar radiation at 200 Mc./s., and was associated with a sudden disturbance of the earth's ionosphere. The increase at 200 Mc./s. had two maxima. The first of these occurred with the initial appearance of the flare prominence, the second with the period of maximum optical intensity. (A; M.S.C.)

A1-52-12 Dodson, Helen W., and Owren, Leif. "[Abstract:] Observation of Active Regions on the Sun by Radio Interferometer and Spectroheliograph," Astronomical Journal, 57, 10-11 (Apr., 1952).

Records of 200-megacycle solar radiation, observed simultaneously with a radio telescope and interferometer, yield information concerning the locations of the sources of bursts of radio emission on the sun's disk. The Cornell radio interferometer, used in such studies, consists of two identical broadside antennas placed 51 wavelengths apart on an east-west line and connected to a common receiver. Observations in 1950 and 1951 gave positions of the sources of two outbursts that accompanied solar flares and of 14 bursts. The observations indicate that burst sources are associated with regions that are found to be active when observed optically. [See also A1-52-02.] (M.S.C.)

A1. RADIATION FROM THE SUN: Observations

A1-52-13 "Effect of the Annular Eclipse of March 7, 1951, on Radio-Wave Propagation," Nature, 169, 361-362 (Mar. 1, 1952).

The substance of a paper by L. H. Martin at the New Zealand Geophysical Conference is reported. Observations were made at Quartz Hill, Wellington, New Zealand, to ascertain the effect of the annular eclipse of March 7, 1951, on radio-wave propagation. Throughout the eclipse, noise on 30 Mc./s. was abnormally low; thirteen minutes after the maximum phase of the optical eclipse it underwent a sudden drop that may have resulted from asymmetry of noise sources on the sun. On frequencies ranging from 9.5 to 11.1 Mc./s., there were sharp "pips" of high-intensity noise of the type associated with sunspots and normally heard on much higher frequencies. Their occurrence indicates a substantial drop in oblique-incidence critical frequency. (M.S.C.)

A1-52-14 Hagen, John P., and Hepburn, Nannielou. "Solar Outbursts at 8.5-mm. Wave-Length," Nature, 170, 244-245 (Aug. 9, 1952).

Five bursts of solar radiation at a wavelength of 8.5 millimeters were observed between May 1 and October 1, 1951, with a radiometer adjusted to follow the sun. The aperture of the antenna was 24 inches and the beam width 1°.1. Tracings of the records are shown. Four of the bursts were accompanied by flares and the fifth occurred when there was an active region at the west limb of the sun. Times of occurrence and amplitudes of the bursts are tabulated, together with data concerning accompanying flares, sudden ionospheric disturbances, and known bursts at other wavelengths associated with the same occurrences. The bursts at 8.5 millimeters differ from those at longer wavelengths in that they have much shorter durations (all less than five minutes) and much smaller amplitudes (increase in total solar radiation not exceeding 27 percent). For one of the bursts, which occurred simultaneously at 8.5 millimeters and 3 centimeters, a transport of material within the sun's atmosphere is unlikely to have been the source of the burst energy. (M.S.C.)

A1-52-15 Hatanaka, Takeo. "[Abstract:] On Noise Storms," Rep. Ion. Res. Japan, 6, No. 3, 164 (1952).

Results of an analysis of noise storms at meter wavelengths are briefly described. [For a full account see A1-52-16.] (M.S.C.)

A1-52-16 Hatanaka, Takeo, and Moriyama, Fumio. "On Some Features of Noise Storms," Rep. Ion. Res. Japan, 6, No. 2, 99-109 (1952). Reprinted as Tok. Astron. Obs. Reprints, No. 99.

Observations of noise storms of solar radio emission in meter wavelengths are analysed. A noise storm seems to occur in a sporadic

manner in a region above a large and magnetically active sunspot. The probability of observing a storm is greatest at the time of the central meridian passage of the spot and falls off to half value two days from it. An intense flare that accompanies a non-polarized outburst seems to act as the exciting mode of a storm. The storm decays exponentially, the order of the time constant being about fifteen to thirty minutes. A right-handed circularly polarized storm is associated with the south pole of a sunspot and vice versa. (A)

A1-52-17 Hulburt, E. O. "The Solar Eclipse of February 25, 1952," Scientific Monthly, 75, 306-309 (Nov., 1952).

Radio and optical observations were carried out during the total solar eclipse of February 25, 1952, by a group of scientists sent to Khartoum, Sudan, by the Naval Research Laboratory, Washington. The experiments included the recording of solar radio emission at wavelengths of 10 centimeters and 8 millimeters. A descriptive account of the work is given and pictures of the equipment are shown. (M.S.C.)

A1-52-18 [Laffineur, M.] "Avec la Mission Française du Bureau des Longitudes pour l'Éclipse Totale de Soleil à Khartoum (25 Février 1952)," Astronomie, 66, 342-349 (Sept., 1952).

An illustrated account of preparations for observing the eclipse of February 25, 1952, at Khartoum is followed by a description of the eclipse itself and of the making of observations at wavelengths of 55 centimeters and 1.17 meters. (For a summary of the preliminary results see A1-52-19.) (M.S.C.)

A1-52-19 Laffineur, Marius, Michard, Raymond, Pecker, Jean-Claude, d'Azambuja, Marguerite, Dollfus, Audoin, and Atanasijević, Ivan. "Observations Combinées de l'Éclipse Totale de Soleil du 25 Février 1952 à Khartoum (Soudan) et de l'Éclipse Partielle au Radio-Télescope de l'Observatoire de Meudon," Comptes Rendus, 234, 1528-1530 (Apr. 7, 1952). Reprinted as Contrib. I. A. P. A, No. 108.

Observations of the total solar eclipse of February 25, 1952, were made in Khartoum at frequencies of 550 and 255 Mc./s., with the aid of an equatorially mounted parabolic reflector of 6-meter diameter and 3.6-meter focal length. At the higher frequency 19.5 percent of the intensity of the radiation of the uneclipsed sun remained at the middle of totality, and at the lower frequency 30.5 percent. At Meudon, where the eclipse was partial, the minimum intensity at 255 Mc./s. occurred thirteen minutes after the maximum of the optical eclipse and amounted to 83 percent of the intensity of the uneclipsed sun. Coronal observations at optical wavelengths were included in the program of the group at Khartoum. (M.S.C.)

A1. RADIATION FROM THE SUN: Observations

A1-52-20 Newton, H. W. "Sunspots" (Section of "Solar Activity" by H. W. Newton and A. K. Das), M. N., 112, No. 3, 332-333 (1952).

Sunspot activity during 1951 is reviewed. Until after the middle of the year most of the spots, especially the bigger ones, occurred within a longitude range confined to one hemisphere of the sun. Throughout a number of solar rotations ending in August, a higher frequency of bursts of solar noise on meter wavelengths and a higher level of the continuous radiation on centimeter wavelengths was associated with this same hemisphere than with the other. (M.S.C.)

A1-52-21 Payne-Scott, Ruby, and Little, A. G. "The Position and Movement on the Solar Disk of Sources of Radiation at a Frequency of 97 Mc/s. III. Outbursts," Aust. J. Sci. Res. A, 5, 32-46 (Mar., 1952).

The apparent position and polarization of the source of solar radiation at 97 Mc./s. were measured during six outbursts, for five of which data on the accompanying solar flares are available. Initially the apparent position of outburst and flare almost coincide, the outburst usually being rather closer to the solar limb than the flare. As the outburst proceeds, its position rapidly changes, the apparent movement usually being towards, and sometimes off, the solar limb. The initial apparent displacement towards the solar limb and the subsequent movement can be explained if we assume that the outburst radiation is excited by some physical agency originating at the same time, and in the same region, as the flare, and moving outward through the corona. The velocity of such an agency would need to be between 500 and 3000 kilometers per second, and it is suggested that the corpuscular streams associated with sudden-commencement terrestrial magnetic storms are the initiators of outbursts. The polarization of the outbursts in the early stages is random. Often a second increase occurs, with elliptical, usually circular, polarization. On two occasions linear polarization was observed in this later stage of an outburst. The relation between the changes in polarization and the associated changes in apparent position conform to the rule given in Part II [A1-51-26], that right-hand circular polarization arises in the region above a south magnetic pole and left-hand above a north pole, while linear polarization appears to originate above the central region of a bipolar group, the E-vector having a direction approximately along the axis of the spot group. (A)

A1-52-22 Pecker, Jean-Claude. "L'Observation de l'Éclipse du 25 Février à Khartoum," Nature; Revue des Sciences et de leurs Applications, No. 3207, 193-199 (July, 1952).

Observations both at optical wavelengths and at radio wavelengths of 55 centimeters and 117 centimeters were included in the program of the French expedition for observation of the solar eclipse of

February 25, 1952, at Khartoum. An illustrated account of the expedition, with emphasis on its scientific purposes and the work accomplished, is followed by a short description of activities undertaken by other groups during the same eclipse. These included observations at Khartoum at wavelengths of 8.5 millimeters and 10.6 centimeters and observations outside the zone of totality at wavelengths of 2 meters and 55 centimeters. (M.S.C.)

A1-52-23 Redman, R. O. "The Total Solar Eclipse of February 25, 1952," Nature, 169, 686-688 (Apr. 26, 1952).

The author gives an account of the problems investigated by astronomers and technicians gathered in the Sudan for observation of the total solar eclipse of February 25, 1952. Measurements of solar radio radiation were made at wavelengths of 8.5 millimeters and 10.6 centimeters by a party from the Naval Research Laboratory, Washington, and at wavelengths of 55 centimeters and 117 centimeters by a party from the Institut d'Astrophysique, Paris. The data obtained should contribute to the determination of the locations and the physical conditions characterizing the solar levels from which the radiation comes. (M.S.C.)

A1-52-24 Smerd, S. F. "Solar Radio Noise Data," Quarterly Bulletin on Solar Activity (International Astronomical Union), No. 97, 288-291 (Jan.-Mar., 1952); No. 98, 306-308 (Apr.-June, 1952); No. 99, 324-331 (July-Sept., 1952); No. 100, 344-350 (Oct.-Dec., 1952). (1. "Flux"; 2. "Polarisation"; 3. "Variability"; 4. "Outstanding Occurrences.")

The following data on solar radio noise during the year 1952 are tabulated: daily medians of flux in units of 10^{-22} watt $m.^{-2}$ $(c./s.)^{-1}$, daily medians or means of the sense and percentage of polarization, daily indices of variability, and characteristics of outstanding occurrences. The observations were contributed by eleven observing stations, operating at a total of eighteen separate frequencies in the range from 60 to 9400 Mc./s. (M.S.C.)

A1-52-25 "Solar Radio Emission," Bulletin of Solar Phenomena (Tokyo Astronomical Observatory), 4, 13-15 (Jan.-Mar., 1952); 27-29 (Apr.-June, 1952); 41-44 (July-Sept., 1952); 59-62 (Oct.-Dec., 1952). ("Daily Data"; "Outstanding Occurrences.")

The following data pertaining to solar radio emission observed during the year 1952 are tabulated: flux at 200 Mc./s. for each day and for certain shorter intervals, flux at 3000 Mc./s. for each day beginning on October 1, indices of variability at 200, 100, and 60 Mc./s. for each day and for certain shorter intervals, and characteristics of outstanding occurrences at 200, 100, and 60 Mc./s. (M.S.C.)

A1. RADIATION FROM THE SUN: Observations

A1-52-26 von Klüber, H. "Beobachtungen der Sonnenfinsternis vom 25. Februar 1952 im Sudan," Naturwissenschaften, 39, No. 9, 199-206 (May, 1952).

A short review of the scientific objectives of eclipse expeditions is followed by a description of the equipment and observational programs of approximately a dozen expeditions for observing the solar eclipse of February 25, 1952, in the Sudan. Radio-astronomical measurements were planned by two groups. The Institut d'Astrophysique of Paris erected a radio telescope having a parabolic mirror of 6-meter diameter and crossed dipoles for observations at wavelengths of 55 centimeters and 117 centimeters. The U. S. Naval Research Laboratory planned to observe at 9.4 centimeters with a parabolic mirror of 180-centimeter diameter equipped with an electromagnetic horn, and at 8.5 millimeters with a system of two cylindrical parabolic mirrors also equipped with an electromagnetic horn. Pictures of the instruments are shown. (M.S.C.)

See also: A2-52-07, B1-52-04, C1-52-04, C1-52-08, K-52-03, M-52-06, M-52-07, R-52-05, R-52-11, and R-52-15.

SECTION A

RADIATION FROM THE SUN

Part 2. Theories and Interpretations

A2. RADIATION FROM THE SUN: Theories and Interpretations

A2-52-01 "American Astronomers Report," Sky and Telescope, 11, 114-117 (Mar., 1952). ("Solar Enhanced Radiation and Plasma Oscillations," 115-116.)

Hari K. Sen's paper on the interpretation of enhanced solar radio-frequency radiation as an effect of plasma oscillations, presented at the eighty-sixth meeting of the American Astronomical Society, is summarized. [For a detailed account of this work see A2-52-11.] (M.S.C.)

A2-52-02 Feinstein, J. "Condition for Radiation from a Solar Plasma," Phys. Rev., 85, 145-146 (Jan. 1, 1952).

Recent attempts (see A2-51-01 and A2-49-11) to account for bursts of solar radio emission by the mechanism of wave growth in a uniform plasma of infinite extent are criticized on the grounds that the existence of a Poynting vector within a uniform infinite plasma does not form a criterion for the escape of the radiation. The coupling of energy from an oscillating plasma into a radiation field is shown to depend upon the existence of rapid spatial changes in the amplitude of the current distribution of the plasma. (M.S.C.)

A2-52-03 Getmantzev, G. G., and Ginsburg, V. L. "On a Possible Mechanism for the Sporadic Radio Emission of the Sun" [In Russian], Dokl. Akad. Nauk S. S. S. R., 87, No. 2, 187-190 (1952).

The authors consider the possibility that the sun's sporadic radio emission can be interpreted as the radiation of relativistic electrons in the magnetic fields of sunspots, a mechanism analogous to one suggested elsewhere for the galactic radio emission (see B2-51-02 and B2-52-02). For two limiting cases that specify the directions of the electron's motion and radiation with respect to the magnetic field, the authors calculate the energy radiated by the electron and the required concentration of relativistic electrons in the corona over a sunspot. In general both the "ordinary" and "extraordinary" waves are radiated but conditions are more favorable for the "ordinary" wave to be observable. Proton emission appears to be unimportant in the case of the sun but may be of interest in connection with models of radio stars. (M.S.C.)

A2-52-04 Kitamura, Masatoshi, and Kadena, Muneyasu. "[Abstract:] On the Effect of Absorption of the Solar Noise by the Corpuscular Stream," Rep. Ion. Res. Japan, 6, No. 4, 216-217 (1952).

Data on solar flares and outbursts of solar radio noise were analyzed statistically to determine whether these phenomena tended to coincide more frequently in the eastern half of the sun's disk than in the

western half. No significant asymmetry, and therefore no evidence of absorption of solar noise by solar corpuscular streams, was found. (M.S.C.)

A2-52-05 Kwal, Bernard. "Sur le Rayonnement Électromagnétique, Produit par les Chocs d'Électrons dans un Milieu Très Fortement Ionisé," J. Phys. Rad., 13, 35-38 (Jan., 1952). Reprinted as Contrib. I. A. P. B, No. 77.

The electromagnetic radiation of long wavelength produced by electrons in an ionic plasma is discussed according to the classical theory of radiation, and conditions pertaining to the emission and propagation of such radiation in ionized regions of interstellar space and the solar corona are considered. (M.S.C.)

A2-52-06 Link, F. "Radiations Solaires sur 65 cm Pendant l'Éclipse du 12 Septembre 1950," B. C. A. I. C., 3, 81-82 (Nov. 30, 1952).

Reber's observations of solar radiation at a wavelength of 65 centimeters during the total solar eclipse of September 12, 1950, showed an increase of approximately 10 percent in intensity at first and fourth contact (see A1-51-29). It is shown that grazing reflection on the lunar surface fails to account for this phenomenon. An alternative suggestion, according to which the increase is attributed to the influence of a lunar ionosphere, is advanced. Conditions required for the existence of such an ionosphere seem to be fulfilled. The phenomenon under discussion was more pronounced at first than at last contact; this is consistent with the supposition that the lunar ionosphere, like the earth's ionosphere, is better developed on the evening side than on the morning side. The phenomenon has not been noted at other eclipses and careful attempts to observe it are urged. (M.S.C.)

A2-52-07 Maxwell, A. "Possible Identification of a Solar M-Region with a Coronal Region of Intense Radio Emission," Observatory, 72, 22-26 (Feb., 1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 63.

A visually unimportant sunspot group that crossed the sun's meridian on June 14, 1950, was associated with unusually strong radio emission on the meter wavelength band, as reported previously (see A1-51-22). A sequence of geomagnetic storms, traceable throughout the following seven or eight solar rotations, may be ascribed to the synodic return of the same area of the sun, suggesting that the unusual radio emission was associated with the formation of an M-region. Throughout the duration of the sequence, radar auroral echoes showed a strong tendency to occur at times corresponding to the return of the main

M-region or a less important M-region 180° away in heliographic longitude. The main M-region sequence is the only important one prior to which regular radio noise observations have been made. (M.S.C.)

A2-52-08 Purcell, E. M. "The Lifetime of the $2^2S_{1/2}$ State of Hydrogen in an Ionized Atmosphere," Ap. J., 116, 457-462 (Nov., 1952).

The probability of the transitions $2^2S_{1/2} - 2^2P_{1/2}$ and $2^2S_{1/2} - 2^2P_{3/2}$ resulting from collisions of hydrogen atoms in $2^2S_{1/2}$ state with electrons and positive ions is calculated. The dominant effect of the protons is shown. The population of the 2S state under chromospheric conditions is found to be substantially lower than the estimates of Giovanelli, and the appearance of an absorption line at 9882 Mc./s. from the transition $2^2S_{1/2} - 2^2P_{3/2}$ is improbable. (A; M.S.C.)

A2-52-09 Reule, Alfred. "Zur Thermischen Emission der Sonnenkorona im Wellenlängenbereich Zehn Zentimeter bis Zehn Meter," Zeitschrift für Naturforschung, 7a, 234-247 (Mar.-Apr., 1952).

The thermal emission of the sun is calculated for different models of the corona, refraction and density variation being taken into account. On the assumption that the electron density is known and is spherically symmetrical, a procedure is deduced for calculating the temperature in the corona from the measured distribution of intensity over the solar disk. The observational results of Stanier (A1-50-12) are not consistent with the generally accepted distribution of density or a multiple of it. The influence of the ray-structure of the corona is investigated and it is shown that this can cause marked irregularities in the intensity distribution. Analysis of the intensity distribution in one direction only may therefore yield an erroneous interpretation of the results. (A; M.S.C.)

A2-52-10 Sen, Hari K. "An Estimate of the Density and Motion of Solar Material from Observed Characteristics of Solar Radio Outbursts. Abstract," Pub. A. S. P., 64, 228 (Oct., 1952).

"The theory of radio wave generation by multistream charge interaction (A2-51-05) is extended and applied to the observations made by the Australian workers (A1-50-14) of the spectrum of outbursts of solar radio-frequency radiation in the frequency range 70-130 Mc./s. The dispersion equation is derived as a function of the velocity of solar material erupting into a static corona and of the temperatures and densities of the material and the corona. The application of the

dispersion equation to the Australian data enables an estimate to be made of the velocity (~500 kilometers per second) and the density (~10^8 per cubic centimeter) of the moving solar material."

(Reproduced in full)

A2-52-11 Sen, Hari K. "Solar 'Enhanced Radiation' and Plasma Oscillations," Phys. Rev., 88, 816-822 (Nov. 15, 1952). Abstracted in Astronomical Journal, 57, 26-27 (Apr., 1952).

The dispersion relation for a plasma oscillating in a static magnetic field is derived by the Laplace transform method. The plasma oscillations are found to be unstable in frequency bands around multiples of the gyrofrequency. A numerical application to spot magnetic fields at coronal distances indicates sufficient amplification to make plausible the theory of the origin of solar "enhanced radiation" in plasma oscillations of electrons gyrating round the magnetic field of sunspots. (A)

A2-52-12 Takakura, Tatsuo. "The Directivity of Solar Radio Emission from the Sunspots," Rep. Ion. Res. Japan, 6, No. 3, 162 (1952).

The correlation between solar radio emission and a relative sunspot number defined by giving greater weight to sunspots in the central circle zone on the sun's disk than to those in the outer zone was investigated. The results indicate that the locations of sunspots on the disk do not affect the radio emission observed at 3260 Mc./s. At 1200 and 200 Mc./s., on the other hand, the radio emission from the sunspots in the central circle zone appears to be approximately twice as strong as that from the sunspots in the outer zone. (M.S.C.)

A2-52-13 Thomas, Richard N. "[Abstract:] Chromospheric Kinetic Temperature from Radio Measures," Astronomical Journal, 57, 27 (Apr., 1952).

"A major anomaly in the interpretation of the solar chromosphere at the present time is the apparent disagreement between temperatures inferred from optical observations and temperatures inferred from radio measures. In each case the relevant temperature is only a kinetic temperature. In the interpretation of several of the optical observations the departure from thermodynamic equilibrium of the solar chromosphere has appeared to influence appreciably the observations. The radio measures are, currently, interpreted as coming from free-free transitions in the field of the hydrogen ion. Heretofore, the influence of a departure from Maxwellian distribution of the electrons about the kinetic temperature of the chromosphere has been ignored. It appears however that an average relative departure between the high energy and the low energy ends of

the velocity spectrum amounting to one part in one hundred thousand will suffice to cause an error of a factor 2 in the inferred value of the temperature." (Reproduced in full)

A2-52-14 Twiss, R. Q. "Excess Radio Noise from Solar Flares and Sunspots," Nature, 169, 185-186 (Feb. 2, 1952).

The suggestion that the excess noise associated with solar flares and sunspots may be due to longitudinal plasma oscillations is open to criticism on several grounds. Theories involving the amplification of the transverse radiation field itself would appear to be more promising. The author proposes and discusses such a theory, according to which oscillations are excited in a thermal plasma moving with a drift velocity less than the mean thermal velocity between two regions in which the characteristic impedance of the medium changes appreciably within a wavelength. The required conditions might be met in solar flares and sunspots at levels from which the radiation can escape. (M.S.C.)

See also: A1-52-04, A1-52-16, A1-52-21, B2-52-09, M-52-06, and M-52-07.

SECTION B

GENERAL GALACTIC RADIATION

Part 1. Observations

GENERAL GALACTIC RADIATION

SUPPLEMENTARY SUMMARY OF OBSERVED WAVELENGTHS*

Wave-length	Frequency (Mc./s.)	Observatory	Reports
21 cm.		C. S. I. R. O., Australia	B1-52-02, B1-52-03, B2-52-09, M-52-06
		Stichting Radiostraling van Zon en Melkweg, Netherlands	B1-52-05, B1-52-06, B1-52-07, M-52-06
	10^3		
1.2 m.		Observatoire de Meudon, France	B1-52-01
1.4 m.		Cavendish Laboratory, Great Britain	B1-52-08
1.9 m.		University of Manchester, Great Britain	C1-52-02, C1-52-13, M-52-06, R-52-11
2.7 m.		National Bureau of Standards, U. S. A.	B1-52-04
	10^2		
3.7 m.		Cavendish Laboratory, Great Britain	B1-52-08
4 m.		National Bureau of Standards, U. S. A.	B1-52-04
6 m.		National Bureau of Standards, U. S. A.	B1-52-04
8.6 m.		National Bureau of Standards, U. S. A.	B1-52-04
12 m.		National Bureau of Standards, U. S. A.	B1-52-04
	10		

* For explanation see page 3.

B1. GENERAL GALACTIC RADIATION: Observations

B1-52-01 Atanasijević, Ivan. "Mesures du Rayonnement de la Voie Lactée sur 255 Mc/s.," Comptes Rendus, 235, 130-132 (July 16, 1952). Reprinted as Contrib. I. A. P. A, No. 122.

A radio telescope having a parabolic antenna of 7.5-meter diameter with a half-wave dipole and reflector at its focus was used for measuring radiation from the Milky Way at a frequency of 255 Mc./s. The observations consisted of sweeps in azimuth at fixed altitudes. The Sagittarius region was observed when on the meridian, other regions when the galactic plane was near the zenith. A preliminary map of the radio isophotes was derived. A weak maximum, not shown on the contour maps obtained by Reber, appears near galactic longitude 100°. (M.S.C.)

B1-52-02 Christiansen, W. N., and Hindman, J. V. "21 cm. Line Radiation from Galactic Hydrogen," Observatory, 72, 149-151 (Aug., 1952).

Results of a preliminary survey of the 21-centimeter line emission from hydrogen in the galaxy are presented in the form of a diagram showing contour lines of brightness distribution. Observed variations in peak brightness along the galactic equator are attributed both to the spreading of the line energy by Doppler shifts due to differential galactic rotation and to structural features of the galaxy. A splitting of the line into two components occurs between galactic longitudes 170° and 250°. On the assumption that this splitting is an effect of galactic rotation, it is found that large elongated masses of hydrogen forming arcs suggestive of spiral structure lie at distances of about 1 and 4 kiloparsecs from the sun. [For a full description of the work see B1-52-03.] (M.S.C.)

B1-52-03 Christiansen, W. N., and Hindman, J. V. "A Preliminary Survey of 1420 Mc/s. Line Emission from Galactic Hydrogen," Aust. J. Sci. Res. A, 5, 437-455 (Sept., 1952).

A preliminary survey of 1420-Mc./s. hydrogen-line emission was made over 270° of galactic longitude extending through the galactic center and anticenter. The radiation source is in the form of a band of varying intensity along the galactic equator. The maximum brightness temperature is about 100°K, in the direction of the galactic anticenter. Measurements of line profile show considerable variation, with a minimum width of 0.12 Mc./s. Double lines are evident between galactic longitudes 170° and 240° and it is suggested that these may originate in major structural features of the galaxy. The change in the peak brightness of the line along the galactic equator may result from line broadening due to galactic rotation. On the other hand it may reveal the existence of highly emitting regions. The latter interpretation is supported by the agreement

in position of the bright areas for both the line emission and the continuous-spectrum galactic emission. (A)

B1-52-04 Cottony, H. V., and Johler, J. R. "Cosmic Radio Noise Intensities in the VHF Band," Proc. I. R. E., 40, 1053-1060 (Sept., 1952).

During 1948 and 1949, the National Bureau of Standards conducted continuous, broad-directivity measurements of the cosmic radio noise intensities at frequencies between 25 and 110 Mc./s. The purpose was to evaluate the importance of this noise from the standpoint of its interference with radio communication. The results show a regular daily variation in noise corresponding to the movement of the principal sources of cosmic radio noise across the antenna receiving pattern. This normal cosmic noise intensity pattern was found to be constant within the limits of the accuracy of the measurements. The average daily maxima and minima which bracketed the daily variations are presented in tabular form. No measurable change in these limits was observed in the course of the measurements. Besides the normal cosmic radio noise, periods of abnormal high noise levels, generally associated with periods of unusual solar activity, were observed and recorded. (A)

B1-52-05 Muller, C. A. "Meting van Radiostraling uit de Melkweg op 1420 MHz," Tijdschrift van het Nederlands Radiogenootschap, 17, 3-14, and discussion on page 15, (Jan., 1952).

A short general introduction in radio astronomy is followed by a description of a special receiver used for the first observations in the Netherlands of the 1420-Mc./s. line in the spectrum of galactic radiation. (A)

B1-52-06 Oort, J. H. (in collaboration with C. A. Muller). "Spiral Structure and Interstellar Radio Emission," Monthly Notes of the Astronomical Society of South Africa, 11, 65-70 (July 31, 1952). Also with certain additions in South African Journal of Science, 49, 87-92 (Oct.-Nov., 1952).

A discussion of certain of the known facts and unsolved problems concerning spiral structure of galaxies is followed by a summary and provisional interpretation of the results of new measurements of the contours of the emission line of interstellar hydrogen at a wavelength of 21 centimeters. The measured Doppler shifts of the maxima of the line profiles are assumed to correspond to radial velocities due to differential rotation of our galaxy. A provisional relation between circular rotational velocity and distance from the galactic center being adopted, the observations then indicate

that major maxima of the density of interstellar hydrogen are arranged in two spiral arms. The positions of the arms, one of which is strikingly evident at all galactic longitudes between 30° and 130°, are indicated diagrammatically. They show that our galaxy is a spiral of intermediate rather than of late type. The new evidence shows conclusively that the interstellar gas is concentrated in the spiral arms. (M.S.C.)

B1-52-07 Oort, J. H., with van de Hulst, H. C., and Muller, C. A. "Spiraalstructuur van het Melkwegstelsel," Verslag van de Gewone Vergadering der Afdeling Natuurkunde (Koninklijke Nederlandse Akademie van Wetenschappen), 61, 140-143 (Oct. 25, 1952).

The emission line of interstellar hydrogen at 21-centimeter wavelength was observed with the aid of a movable parabolic reflector of aperture $7\frac{1}{2}$ meters. The beam width was 2°.7. Line profiles were obtained at five-degree intervals of galactic longitude over the portion of the galactic plane observable from the Netherlands. In the directions of the galactic center and anticenter the profiles are symmetric and reveal no systematic deviations from circular motion; their width corresponds to an average random radial velocity of 6 kilometers per second for the individual clouds. In other directions the profiles are wider and show several maxima resulting from Doppler shifts due to differential galactic rotation. For the outer parts of the galaxy (outside a circle centered at the galactic center and passing through the sun), the relation between the density of hydrogen and distance from the sun was derived in each direction on the assumption that the systematic motion is circular and depends only on distance from the galactic center. The results, here presented diagrammatically, show that both the regions of maximum and minimum density are arrayed in spiral arms. Except for the longest arm, which is approximately circular, the arms are tilted so that the sense of rotation of the galaxy is that of a spring being wound. (M.S.C.)

B1-52-08 Royal Astronomical Society. "Meeting of the Royal Astronomical Society [Oct. 10, 1952]," Observatory, 72, 213-221 (Dec., 1952). [Material pertaining to extraterrestrial radio noise on pages 215-217.]

Descriptions of current astronomical work in Japan and at the Central Radio Propagation Laboratory of the National Bureau of Standards were presented by [Y.] Hagihara and A. H. Shapley respectively. The work includes studies of solar radio emission. P. A. G. Scheuer and M. Ryle reported on a radio-astronomical investigation of H II regions. Using an interferometric method for obtaining high resolving power, they made a survey of the latitude distribution of galactic radio emission at frequencies of 80 and 210 Mc./s. The results

are consistent with the prediction that at these frequencies the H II regions should appear as a bright strip along the galactic equator. An average temperature of these regions exceeding 18,000° C is indicated but the possibility that the central maximum is due in part to a population of a new type of radio stars showing strong galactic concentration is not ruled out. (M.S.C.)

See also: B2-52-09, C1-52-02, C1-52-13, M-52-06, and R-52-11.

SECTION B

GENERAL GALACTIC RADIATION

Part 2. Theories and Interpretations

B2. GENERAL GALACTIC RADIATION: Theories and Interpretations

B2-52-01 Binge, Hans-Jost. "Vergleich Solarer Erscheinungen mit der Veränderlichkeit von Sternen in Gasnebeln," Zeitschrift für Naturforschung, 7a, 440-444 (June, 1952). [Material pertaining to extraterrestrial radio noise on page 444.]

The peculiarities of RW Aurigae stars are interpreted as effects of a phenomenon analogous to sunspot activity but very much stronger. It is suggested that eruptions on these stars, analogous to those producing intense radio emission on the sun, are the source of most of the galactic radio radiation. (M.S.C.)

B2-52-02 Getmantzev, G. G. "Cosmic Electrons as the Source of the Radio Radiation of the Galaxy" [In Russian], Dokl. Akad. Nauk S. S. S. R., 83, No. 4, 557-560 (1952).

An analysis of the proposition that cosmic noise in the meter-wave band is due to electrons with relativistic energies yields a theoretical answer not in disagreement with experimental data. (P:J.M.Hough)

B2-52-03 Hutchinson, G. W. "On the Possible Relation of Galactic Radio Noise to Cosmic Rays," Phil. Mag., 43, 847-852 (Aug., 1952).

The possibility that cosmic rays are accelerated in regions of the galaxy of intermediate particle density ($\approx 10^{9}$ cm.$^{-3}$) is considered. It is found that a conservative estimate of the magnetic fields in such regions would lead to a radio noise flux of the observed order of magnitude, and that the observed spectrum could easily be produced. A possible cause is suggested for the low-energy cut-off in the cosmic-ray spectrum. If the proposed mechanism accounts for any large proportion of the cosmic rays, these should be accompanied by a small flux of γ quanta which should show the same anisotropy as the galactic radio noise. (A)

B2-52-04 Korchak, A. A., and Terletzky, Ya. P. "Electromagnetic Radiation of Cosmic-Ray Protons and Galactic Radio Radiation" [In Russian], Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki, 22, 507-509 (Apr., 1952).

Radiation by cosmic-ray protons moving in magnetic fields in the galaxy is suggested as a possible explanation of the galactic radio emission. The spectral distribution of such radiation is calculated and found to be in reasonably good agreement with the spectrum of galactic radio emission as determined observationally. Both the cosmic rays and the radio emission would originate in regions having a high density of cosmic particles and a high magnetic field. (M.S.C.)

B2. GENERAL GALACTIC RADIATION: Theories and Interpretations

B2-52-05 Oort, J. H. "Problems of Galactic Structure," Ap. J., 116, 233-250 (Sept., 1952).

The author's Henry Norris Russell Lecture delivered on December 27, 1951, is reproduced. It contains a detailed summary and evaluation of the status of knowledge concerning the structure of our galaxy. The interrelationships between the results obtained by optical and by radio techniques of investigation are brought out, and profitable avenues for further research are suggested. The possibilities of obtaining significant information from observations of the emission line of interstellar hydrogen at 21-centimeter wavelength are emphasized. (M.S.C.)

B2-52-06 Shklovsky, I. S. "Radio-Spectroscopy of the Galaxy" [In Russian], Astronomicheskii Zhurnal, 29, 144-153 (Mar.-Apr., 1952).

This paper develops the theory of the monochromatic radio emission of the galaxy, taking into account the extraordinarily low kinetic temperature of the interstellar gas in the H I zones. In directions where the differential galactic rotation is not an important factor, the contour of the line at $\lambda = 21$ centimeters is determined by the individual velocities of clouds of interstellar gas. Although the optical thickness of the galaxy in the direction of its center is very great, nevertheless the observed half-width of this line makes it possible to estimate the total number of hydrogen atoms in a column of unit cross section extending across the entire galaxy. It is of the order of 10^{23} per square centimeter. This permits us to conclude that the total mass of the interstellar gas amounts to only a small percentage of the total mass of the galaxy. The possibility of observing the individual clouds of non-ionized interstellar hydrogen is demonstrated. The differential galactic rotation to a considerable extent renders the galaxy transparent to the 21-centimeter wavelength in a number of directions. If the abundance-ratio of deuterium to hydrogen is more than 1/1000, it is to be expected that the radio spectrum of the galaxy, in the direction toward the galactic center, will exhibit an absorption line of deuterium at a wavelength of 84.5 centimeters. A possibility of studying the isotopic composition of the interstellar gas is thus revealed. (A)

B2-52-07 Shklovsky, I. S. "On the Nature of the Radio Radiation of the Galaxy" [In Russian], Astronomicheskii Zhurnal, 29, 418-449 (July-Aug., 1952).

Unsöld's conclusion that the interstellar ionized gas contributes little to the observed galactic radio radiation is rejected. The radiation has two components: one component originates in the gas and is apparent mostly on short wavelengths, the other originates

in radio stars and is apparent mainly on long wavelengths. The division of the observed intensity of radio emission into these components for different wavelengths and for different parts of the sky is discussed. It is concluded that the secondary maxima in Cygnus, in Vela, and in the field around the anticenter are entirely attributable to interstellar gas. The distribution of intensity of the gas component also reveals certain features of the spiral structure of our galaxy. From the distribution of the intensity of the component that originates in radio stars, it is found that the radio stars form a spherical system, their density in the center being only 2.7 times greater than in the neighborhood of the sun. Thus the spatial distribution of radio stars differs greatly from that of all other known objects in the galaxy. The author presents arguments for the assertion that the five brightest radio stars are a special type of galactic object and probably unique. The total number of radio stars in the galaxy is derived; it greatly exceeds the number of ordinary stars and the masses of the radio stars must therefore be small. (A; M.S.C.)

B2-52-08 Shklovsky, I. S. "On the Spatial Distribution of the Sources of the Galactic Radio Emission" [In Russian], Dokl. Akad. Nauk S. S. S. R., 85, No. 6, 1231-1234 (1952).

The analysis of four papers (Piddington, B2-51-03; Bolton and Westfold, B1-50-02; Allen and Gum, B1-50-01; Hey, Phillips, and Parsons, B1-46-02) yields the following general characteristics of the isophotes of galactic radio emission: (1) the maximum of radio intensity near the center of the galaxy, (2) three secondary maxima (two "sharp" ones in Cygnus and Vela, and a flat one near the anticenter), and (3) a considerable intensity near the galactic poles. The division of radio emission into two components (ionized interstellar gas and radio stars) shows that the secondary maxima are of interstellar origin. In the region of the galactic center the gaseous component plays the main part up to $\lambda = 300$ centimeters. It follows that the radio stars are not concentrated in the plane of the galaxy, and that their intensity component in the center is only 4.4 times that in the anticenter; the value of $d(\log n)/dR$ for radio stars is -0.056, i.e., about one-half of that for the Cepheids. [See also B2-52-07.] (P: F. Lachman)

B2-52-09 Wild, J. P. "The Radio-Frequency Line Spectrum of Atomic Hydrogen and its Applications in Astronomy," Ap. J., 115, 206-221 (Mar., 1952).

Formulas are obtained for the frequencies, transition probabilities, and natural widths of the discrete lines of atomic hydrogen that fall within the radio spectrum. Such lines are due to transitions within either the fine structure or the hyperfine structure of the energy

levels. The conditions necessary for the formation of observable emission and absorption lines are examined. Thence an inquiry is made into which of the hydrogen lines are likely to be observable from astronomical systems. It is found that the sun may give a detectable absorption line at about 10,000 Mc./s., corresponding to the $2^2S_{1/2} - 2^2P_{3/2}$ fine-structure transition, but that other solar lines are not likely to be observable. From the interstellar gas, the emission line already observed (i.e., the 1420 Mc./s. hyperfine-structure line) is probably the only detectable hydrogen line. The importance of this line in the study of the interstellar gas is discussed. Some general conclusions are drawn from the preliminary evidence regarding the motion and kinetic temperature of the regions of un-ionized hydrogen. The radio data are used to obtain a measure of the product of "galactic thickness" and average hydrogen concentration. (A)

B2-52-10 Wouthuysen, S. A. "On the Excitation Mechanism of the 21 cm Interstellar Hydrogen Emission Line," Physica, 18, 75-76 (Jan., 1952).

The absorption and re-emission of Lyman-α resonance radiation trapped in H I regions of interstellar space cause a redistribution of the two components of the ground state of the atom and establish equilibrium between the internal and translational degrees of freedom. The relative populations of the two hyperfine-structure levels depend on the shape rather than the intensity of the spectrum of the Lyman-α radiation. This shape will be that of the Planck spectrum for the kinetic temperature of the cloud, and the kinetic temperature will then become the "population temperature." [See also B2-52-11.] (M.S.C.)

B2-52-11 Wouthuysen, S. A. "[Abstract:] On the Excitation Mechanism of the 21-cm (Radio-Frequency) Interstellar Hydrogen Emission Line," Astronomical Journal, 57, 31-32 (Apr., 1952).

"The mechanism proposed here is a radiative one: as a consequence of absorption and re-emission of Lyman-α resonance radiation, a redistribution over the two hyperfine-structure components of the ground level will take place. Under the assumption — here certainly permitted — that induced emissions can be neglected, it can easily be shown that the relative distribution of the two levels in question, under stationary conditions, will depend solely on the shape of the radiation spectrum in the Lα region, and not on the absolute intensity. ... The conclusion is that the resonance radiation provides a long-range interaction between gas atoms, which forces the internal (spin-)degree of freedom into thermal equilibrium with the thermal motion of the atoms." [See also B2-52-10.]
(First and last paragraphs only reproduced in full)

B2-52-12 Wyatt, Stanley P., Jr. "[Abstract:] A Radio Model of the Galaxy," <u>Astronomical Journal</u>, 57, 168-169 (Oct., 1952).

Radio isophotes determined by Bolton and Westfold at 100 Mc./s. are analyzed on the assumptions that the radio galaxy is axially symmetric and that it is transparent at 100 Mc./s. The density function in the galactic plane is found to be approximately Gaussian with the sharpest decay in the regions two to four kiloparsecs from the center. Superposed on this are a constant component with brightness temperature about 450°K and an asymmetric component in the anticenter directions. On the assumption that the density distribution in the z-direction follows a Gaussian law, the decay rate for the nuclear part of the galaxy is five times as rapid at right angles to the galactic plane as in the plane, and for the solar neighborhood three times as rapid. Only a small part of the constant 450° excess can be attributed to other galaxies radiating like our own. (M.S.C.)

See also: A2-52-05, B1-52-03, B1-52-06, B1-52-07, B1-52-08, C1-52-02, and C1-52-10.

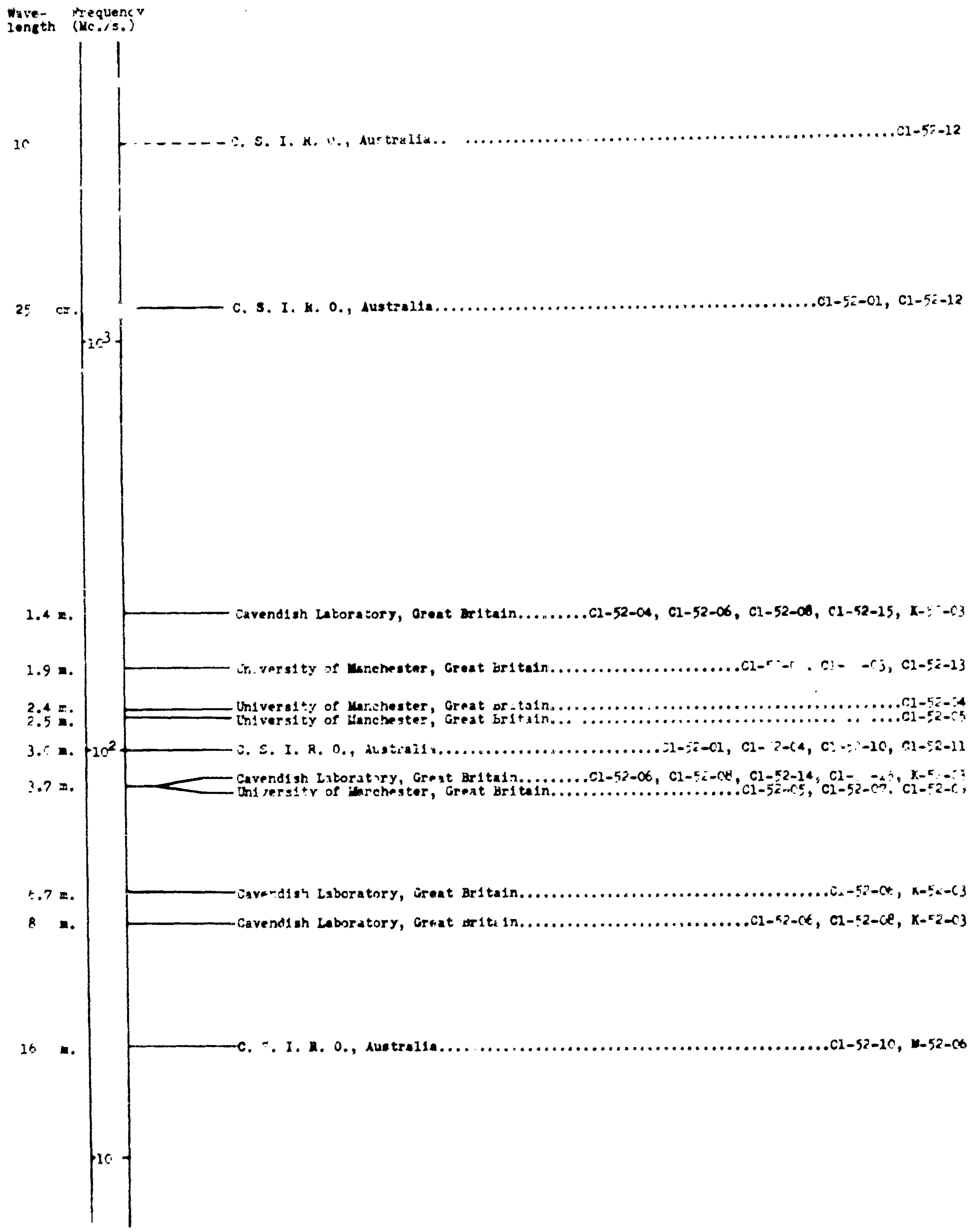
SECTION C

RADIATION FROM "DISCRETE SOURCES"

Part 1. Observations

RADIATION FROM "DISCRETE SOURCES"

SUPPLEMENTARY SUMMARY OF OBSERVED WAVELENGTHS*



*Positive results are indicated by solid lines, negative results by dotted lines. For further explanation see page 3.

C1. RADIATION FROM "DISCRETE SOURCES": Observations

C1-52-01 Bracewell, Ronald. "Radio Stars or Radio Nebulae?," Observatory, 72, 27-29 (Feb., 1952).

Observations by B. Y. Mills, indicating the existence of two discrete radio sources (in Sagittarius and Vela) with angular extensions of about 35', raise the question whether all discrete sources are "radio nebulae." The principle of the apparatus used by Mills is explained and characteristics of an extended discrete source in Cygnus, as determined by Piddington and Minnett [see C1-52-12], are briefly described. (M.S.C.)

C1-52-02 Brown, R. Hanbury, and Hazard, C. "Extra-Galactic Radio-Frequency Radiation," Phil. Mag., 43, 137-152 (Feb., 1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 61.

It has been shown previously that radio-frequency radiation is being received on the earth from the extragalactic nebula NGC 224 (M 31). This paper reports some initial attempts to extend the measurements of extragalactic radio radiation at a wavelength of 1.89 meters. A radio survey was made of three bright nebulae (in addition to NGC 224) and three radio sources were associated with them. The radio intensity to be expected from eight of the major clusters of nebulae was calculated and two of the clusters were surveyed and identified with radio sources. For a selected region of the sky an attempt was made to predict the irregularities in the radio isophotes corresponding to large-scale irregularities in the distribution of extragalactic nebulae. These predictions were compared with radio observations of the region, and it is shown that there is a correlation between the radio isophotes and the distribution of extragalactic nebulae. A preliminary examination was made of the relation between the apparent photographic magnitude and the apparent radio magnitude of the nebulae. The results suggest that there is a definite relationship and that the apparent photographic magnitude increases more rapidly than the apparent radio magnitude. (A)

C1-52-03 Brown, R. Hanbury, and Hazard, C. "Radio-Frequency Radiation from Tycho Brahe's Supernova (A. D. 1572)," Nature, 170, 364-365 (Aug. 30, 1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 72.

A number of localized sources were detected in the course of a detailed survey of the radiation at 158.5 Mc./s. from the region of the sky lying within the field of view of the 218-foot paraboloid at the Jodrell Bank Experimental Station. One of the sources agrees in position with the supernova of 1572 and is tentatively identified as its remnant. In contrast to the Crab Nebula, which is believed to be the remnant of the supernova of 1054 and has previously been iden-

tified as a radio source, the remnant of the supernova of 1572 has not been observed optically. The two radio sources differ in intensity by about 2.5 magnitudes, as did the apparent visual magnitudes of the two supernovae at maximum brightness, but the remnants differ by at least 6 magnitudes in integrated photographic magnitude. No radio source has yet been detected at the position of the other supernova (that of 1604) known to have occurred in the galaxy. (M.S.C.)

C1-52-04 Brown, R. Hanbury, Jennison, R. C., and Das Gupta, M. K.; Mills, B. Y.; Smith, F. G. "Apparent Angular Sizes of Discrete Radio Sources," Nature, 170, 1061-1065 (Dec. 20, 1952). First part reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 76.

The results of three separate experimental investigations of the angular sizes of discrete radio sources are presented. Interferometer techniques with a variety of antenna spacings were used in all cases. The two most intense sources were observed at the Jodrell Bank Experimental Station at a frequency of 125 Mc./s. with antennas spaced along four different base lines; they were found to have apparent angular sizes of the order of a few minutes of arc. The source in Cygnus was found to be markedly asymmetrical in angular size, that in Cassiopeia roughly symmetrical. In Australia, the effective sizes of Cygnus A, Taurus A, Virgo A, and Centaurus A were measured in the east-west direction at a frequency of 100 Mc./s. Values of 1'.1, 4', 5', and 6' respectively were obtained. Previously suggested identifications of these sources with certain nebulae are confirmed by the fact that in all four cases the dimensions of the radio and optical objects are comparable. At the Cavendish Laboratory the intense sources in Cygnus and Cassiopeia were measured at a wavelength of 1.4 meters. The results were consistent with those to be expected from uniformly bright disks having diameters of 3.5 and 5'.5 respectively. (M.S.C.)

C1-52-05 Burrows, K., and Little, C. G. "Simultaneous Observations of Radio Star Scintillations on Two Widely Spaced Frequencies," Astron. Contrib. U. Man. I, Jodrell Bank Annals, 1, 29-35 (Dec., 1952).

Observations of the scintillation of a radio star were made simultaneously at frequencies of 81.5 and 118.5 Mc./s. The average cross-correlation coefficient between the scintillation records on the two frequencies was 0.61, with a standard deviation of 0.13. No systematic variation of cross-correlation coefficient with fluctuation rate or source elevation was found; the correlation showed a tendency to decrease with increasing amplitude of fluctuations. The experimental results are in general agreement with previous observations in England, but do not agree with earlier observations in Australia. (A)

C1. RADIATION FROM "DISCRETE SOURCES": Observations

C1-52-06 Hewish, A. "The Diffraction of Galactic Radio Waves as a Method of Investigating the Irregular Structure of the Ionosphere," Proc. Roy. Soc. A, 214, 494-514 (Oct. 9, 1952).

The amplitudes of the radio waves received from a radio star at two points separated by about 1 kilometer were studied and compared. The results indicate that the variations of phase and amplitude at one point can be ascribed to the steady drift of an irregular wave-pattern over the ground. It is shown how the structure and movement of the wave-pattern can be deduced from the observations. The irregular wave-pattern across the ground can be thought of as a diffraction pattern produced by the passage of the waves through a portion of the ionosphere which imposes irregular changes of phase on it, and it is shown how the ionospheric characteristics can be deduced. The ionospheric irregularities are shown to have a lateral extent of the order 2 to 10 kilometers, and a variation of electron content of about 5×10^9 electrons per square centimeter. It is deduced that the irregularities are at a height of about 400 kilometers. They are most pronounced around midnight and exhibit little annual variation. The irregular portion of the ionosphere moves with a steady wind-like motion with a velocity of the order 100 to 300 meters per second. The velocity decreases after midnight, and large velocities are associated with periods of magnetic disturbance. (A)

C1-52-07 Little, C. G., and Maxwell, A. "Scintillation of Radio Stars During Aurorae and Magnetic Storms," J. Atmos. Terr. Phys., 2, No. 6, 356-360 (1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 73.

During aurorae, the scintillations of radio stars are, on the average, four times more rapid than during normal conditions. This increase in the scintillation rate is believed to result from a fourfold increase in the steady drift motion of the ionospheric irregularities which cause the scintillations. More generally, it is found that the scintillation rate, and the velocity of the ionospheric irregularities, are approximately proportional to the K index of geomagnetic activity. (A)

C1-52-08 Machin, K. E., and Smith, F. G. "Occultation of a Radio Star by the Solar Corona," Nature, 170, 319-320 (Aug. 23, 1952).

Interferometers of large resolving power were used for measuring the intensity of radiation at 210, 81.5, and 38 Mc./s. from the radio star in Taurus (05.01) during a close passage of the sun in the period June 5-20, 1952. The occulting effect of the solar corona could be accurately observed only at the two lower frequencies since a small

sunspot caused disturbances at 210 Mc./s. At both 81.5 and 38 Mc./s. the records showed a reduction of amplitude when the separation of the sun's center from the radio star was ten times the angular radius of the sun's visible disk, a separation considerably greater than that for which an observable effect had been predicted. The reduction could be attributed either to an actual decrease of flux density at the earth, or to an increase of the apparent angular diameter of the radio star possibly due to irregularities of electron density in the outer corona. The observations at 38 Mc./s. are consistent with an increase of apparent diameter from 15' to 45' as the separation decreased from 10 to 4.5 solar radii. The corresponding figures for 81.5 Mc./s. are 8' and 25'. (M.S.C.)

C1-52-09 Maxwell, A., and Little, C. G. "A Radio-Astronomical Investigation of Winds in the Upper Atmosphere," Nature, 169, 746-747 (May 3, 1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 68.

Fluctuations of the radiation at 80 Mc./s. from the intense radio stars in Cygnus and Cassiopeia were observed with three receivers arranged triangularly at spacings of approximately 4 kilometers. Small displacements in the times of occurrence of individual fluctuations at the various stations indicated the drift on the ground of the diffraction pattern produced by irregularities in the F-region of the ionosphere and from this the horizontal component of the ionospheric motion was deduced. The F-region irregularities were found to have a steady translational movement with an average velocity of approximately 350 kilometers per second and with the prevailing direction towards the west. Observations at low angles of elevation (which were carried out in May and June, 1951, and pertained to ionospheric conditions at a mean latitude of 60°N) yielded a lower mean velocity towards a more northward direction than observations near the zenith (which were carried out in September and October, 1951, and pertained to latitude 53°N). Usually the direction of movement remained steady for many hours but on two occasions it was observed to change by 140° within an hour. The rate of fluctuation bears a linear relationship to the velocity of the diffraction pattern across the ground and the variations in this rate are therefore due to changes in the velocity rather than the size of the F-region irregularities. (M.S.C.)

C1-52-10 Mills, B. Y. "The Distribution of the Discrete Sources of Cosmic Radio Radiation," Aust. J. Sci. Res. A, 5, 266-287 (June, 1952), and correction, Aust. J. Phys., 6, 125 (Mar., 1953).

Seventy-seven discrete sources of cosmic radio radiation were observed at a frequency of 101 Mc./s. with a Michelson-type interferometer

equipped with a sensitive receiving system. The positions of the sources are given to sufficient accuracy for statistical analysis, and their galactic distribution is examined. It is found that the distribution can be explained on the assumption that the sources can be separated into two major classes, one having a high degree of galactic concentration and the other having a random distribution. The possible identification of the sources with various types of astronomical objects is discussed, and it is concluded that, although some of the evidence is suggestive, it is insufficient for any positive conclusions to be formed. (A; M.S.C.)

C1-52-11 Mills, B. Y. "The Positions of Six Discrete Sources of Cosmic Radio Radiation," Aust. J. Sci. Res. A, 5, 456-463 (Sept., 1952).

Accurate positions were measured at a frequency of 100 Mc./s. for the following six discrete sources of cosmic radio radiation: Cygnus A, Centaurus A, Virgo A, Taurus A, Hydra A, and Fornax A. Systematic and random errors influencing the observations are discussed. Three of the sources, Taurus A, Centaurus A, and Virgo A, were previously identified with nebulae by Bolton, Stanley, and Slee; these identifications appear to be confirmed. It is also found that Centaurus A and Fornax A have measurable angular sizes (about $\frac{1}{2}^{\circ}$). (A; M.S.C.)

C1-52-12 Piddington, J. H., and Minnett, H. C. "Radio-Frequency Radiation from the Constellation of Cygnus," Aust. J. Sci. Res. A, 5, 17-31 (Mar., 1952).

Observations, at frequencies of 1210 and 3000 Mc./s., of the radiation from a portion of the constellation of Cygnus are described. Two sources of radiation were observed at the lower frequency, one being the well-known "radio star," Cygnus A. The other was a diffuse source of limited extent which might be called a "radio nebula." Neither source could be observed at the higher frequency. The properties of both sources, particularly their spectra, are discussed and it is shown that earlier discrepancies in observations of the Cygnus region may be explained. The diffuse source coincides in position with the secondary maximum in the lower frequency galactic contours, which Bolton and Westfold (B1-50-02, B2-50-02) have interpreted as a spiral arm of the galaxy. The new evidence suggests that the source is probably due to thermal emission from clouds of ionized interstellar gas, possibly in the region of γ Cygni and having a temperature and electron density of the order of 10^4 °K and 10 per cubic centimeter respectively. (A)

C1-52-13 Royal Astronomical Society. "Meeting of the Royal Astronomical Society at Leeds [July 25, 1952]," Observatory, 72, 183-191 (Oct.,

1952). [Material pertaining to extraterrestrial radio noise on pages 184-185.]

Papers presented and discussed at the meeting included an account by R. Hanbury-Brown of a radio survey of a portion of the Milky Way. From observations made with the 218-foot paraboloid at the Jodrell Bank Experimental Station, he and [C.] Hazard obtained radio isophotes over a 24-degree band of declination extending from Perseus to Cygnus. Among the localized sources detected was one tentatively identified as the remnant of the supernova of 1572. [See also C1-52-03.] (M.S.C.)

C1-52-14 Smith, F. G. "Ionospheric Refraction of 81.5 Mc/s Radio Waves from Radio Stars," J. Atmos. Terr. Phys., 2, No. 6, 350-355 (1952).

Ionospheric refraction of radio waves from radio stars may cause variations in the apparent right ascensions of the stars because of horizontal gradients in the total ionization of the ionosphere. These gradients occur during the normal diurnal changes of the F-region, and observations of their magnitude allow an estimate to be made of the total ionization of the F-region, including the part above the maximum of ionization density. An account is given of measurements of the refraction of 81.5 Mc./s. radio waves from four radio stars. The results are compared with calculations made from the results of ionospheric soundings, and they are found to be in agreement if certain plausible assumptions are made about the distribution of electrons in the F-region. (A)

C1-52-15 Smith, F. G. "The Measurement of the Angular Diameter of Radio Stars," Proc. Phys. Soc. B, 65, 971-980 (Dec. 1, 1952).

A new method of using interferometers to measure the diameters of radio stars is described. The method is based on the use of the phase-switching system, and has several practical advantages over previous methods. Measurements which were made on the radio star (23.01) in Cassiopeia, indicate that the radio star has an angular diameter of about 5', the exact value depending on the distribution of brightness across the star. A gaseous nebula reported by Baade, in the same position as the radio star, has about the same diameter. Some measurements were also made on the radio star (1901) in Cygnus, and this star appears to have an angular diameter of about $3\frac{1}{2}'$. (A)

See also: K-52-03, M-52-06, and M-52-11.

SECTION C

RADIATION FROM "DISCRETE SOURCES"

Part 2. Theories and Interpretations

C2. RADIATION FROM "DISCRETE SOURCES": Theories and Interpretations

C2-52-01 Bochníček, Záviš. "Radio Waves from Extragalactic Nebulae" [In Czech], Ríše Hvězd, 33, 61-64 (Mar., 1952).

A brief review of early observations and attempted interpretations of galactic radio radiation is followed by a summary of the known information concerning discrete radio sources. For thirteen of the sources located by Ryle, Smith, and Elsmore [see C1-50-04], identifications with visually observable celestial bodies (including two novae, one planetary nebula, and ten extragalactic nebulae) are suggested. Puzzling considerations affecting the interpretation of the nature of radio sources are enumerated. (M.S.C.)

C2-52-02 "Identification of Extended Radio Sources" [Section of the report of the Mount Wilson and Palomar Observatories] (In Carnegie Institution of Washington. Year Book No. 51, July 1, 1951-June 30, 1952. Washington, Carnegie Institution of Washington, 1952. pages 14-15.)

Identifications of three cosmic radio sources with astronomical objects are reported. Minkowski found that Puppis A corresponds in position to a mass of peculiar filaments having random velocities of ±50 kilometers per second and Baade identified Cassiopeia A with the center of a very remarkable emission nebula. At the position of Cygnus A, Baade found a very queer object that can be interpreted as two extragalactic nebulae in collision. The object has a strong emission spectrum with a red shift of 16500 kilometers per second. In each of the three cases the radio and optical objects have similar diameters. (M.S.C.)

C2-52-03 Kahn, F. D. "On Some Possible Mechanisms of Radio Stars. I. The Crab Nebula," M. N., 112, No. 5, 514-517 (1952). Reprinted as Astron. Contrib. U. Man. III, No. 6.

It is assumed, first, that the radio noise emitted by the Crab Nebula is due to the deflection of fast electrons (with a velocity of about 10^{10} centimeters per second) in fields of force with atomic dimensions. The total energy output necessary for this process is found to be improbably large. It is further shown that it is not possible to explain the observed intensity of radio noise by free-free transitions due to electrons with thermal velocities only. (A)

C2-52-04 Shklovsky, I. S. "On the Nature of the Radio Star Emission" [In Russian], Dokl. Akad. Nauk S. S. S. R., 85, No. 3, 509-512 (1952).

It has previously been shown (see B2-52-07) that radio stars are of two types: (1) intense ones that are few in number and are associated

with the galactic equator or with particular galactic nebulae, and (2) "ordinary" ones that are more numerous than optical stars, are not concentrated toward the galactic equator, and show little concentration toward the galactic center. The hypothesis that the radiation of radio stars is produced by retardation of electrons in interstellar magnetic fields is applicable to radio stars of the first type only. For radio stars of the second type this mechanism would yield a much higher concentration of radio emission to the zone of the Milky Way than is observed. These "ordinary" radio stars are considered to be stars of a special kind that have low optical luminosities and small masses and are generators of cosmic rays. The retardation of protons in strong magnetic fields in their atmospheres is suggested as the mechanism of their radio emission. The required concentration of relativistic protons is calculated and found to be extremely high. Radio stars of the first type are tentatively interpreted as former or future supernovae, objects which, according to a concept advanced by Mustel, have enormous masses that cause their radiation to be shifted gravitationally to extremely long wavelengths. (M.S.C.)

C2-52-05 Shklovsky, I. S., and Kholopov, P. N. "Identification of the Nebula NGC 1316 with the Radio Star in the Constellation Fornax" [In Russian], Astronomicheskii Tsirkuliar (Akademiia Nauk S. S. S. R. Biuro Astronomicheskikh Soobshchenii), No. 131, 2-3 (Oct. 31, 1952).

The nebula NGC 1316 is similar in appearance to the nebula NGC 5128, which has been identified as a strong source of radio emission. Thus it is reasonable to think that the radio star observed at $3^h\ 11^m$, -36° (see C1-50-06) is identical with NGC 1316 whose coordinates are $3^h\ 20^m.8$, $-37^\circ\ 24'$, since the error in the position of a radio star may easily be as large as 2°. (N:A.N.V.)

C2-52-06 Shklovsky, I. S., and Parenago, P. P. "Identification of the Supernova of A.D. 369 with a Powerful Radio Star in Cassiopeia" [In Russian], Astronomicheskii Tsirkuliar (Akademiia Nauk S. S. S. R. Biuro Astronomicheskikh Soobshchenii), No. 131, 1-2 (Oct. 31, 1952).

A comparison of positions of novae published by Lundmark in 1921 with positions of recently discovered radio stars indicates that a very powerful radio star at $23^h\ 21^m\ 12^s$, $-58^\circ\ 32'$ (see C1-51-08 and K-52-02) is situated close to the place where a "nova" was observed during six months of A.D. 369. The star reached a maximum magnitude of -3, and its probable coordinates were $0^h \pm$, $+60^\circ \pm$. The discrepancy of 6° is not large if one takes into account that no accurate position of the star was recorded at the time of its appearance. Lundmark lists another star in the position 0^h, $+64^\circ$, which was recorded in A.D. 945, but he considers its appearance as quite uncertain; its

magnitude was not recorded. The authors think that if interstellar absorption is taken into account, the maximum magnitude of the "nova" of A.D. 369 must have been at least -7, which puts it in the class of supernovae. (N:A.N.V.)

See also: A2-52-03, B2-52-07, B2-52-08, C1-52-02, C1-52-03, C1-52-04, C1-52-06, C1-52-07, C1-52-09, C1-52-10, C1-52-11, C1-52-12, C1-52-13, C1-52-14, C1-52-15, K-52-02, M-52-01, M-52-03, M-52-05, M-52-06, M-52-08, M-52-14, and R-52-20.

SECTION X

TECHNIQUES

K. TECHNIQUES

K-52-01 Machin, K. E., Ryle, M., and Vonberg, D. D. "The Design of an Equipment for Measuring Small Radio-Frequency Noise Powers," Proc. I. E. E. III, 99, 127-134 (May, 1952).

The design of an equipment for the continuous recording of the very small radio-frequency noise powers received from the sun and the galaxy is discussed. It is first shown how a noise power can be described in terms of an equivalent temperature, and how cable attenuation affects the noise power measured at the end of an antenna feeder. The fundamentals of the measurement of noise power are considered; it is shown that the minimum detectable power is determined by the receiver noise and by the ratio of input and output bandwidths of the receiver. The practical difficulties inherent in the measurement have been overcome by the design of a self-balancing equipment in which a locally generated noise power is continuously adjusted to equality with the incoming power. A description of such an equipment is given; the design of the radio-frequency switch, the local noise source, the receiver, and the control circuits for the noise source are considered in some detail. The performance of the equipment is analyzed in terms of its accuracy, its response to a step function of input, and the fluctuations of its output indication. Experimental determinations of the performance are found to compare reasonably well with theory. (A)

K-52-02 Royal Astronomical Society. "Meeting of the Royal Astronomical Society [May 9, 1952]," Observatory, 72, 98-106 (June, 1952). [Material pertaining to extraterrestrial radio noise on pages 99-101.]

F. G. Smith presented a paper in which he suggested and discussed three new methods for determining the position of a radio star. [For a full account see K-52-04.] After the positions of the four major radio stars had been determined by these methods [see C1-51-08], a small nebulous object was found by Dewhirst near the radio source in Cassiopeia [see C2-51-01]. This object was subsequently identified by Baade as a bright knot in a ring-shaped nebulosity whose center coincides exactly with the source. (M.S.C.)

K-52-03 Ryle, M. "A New Radio Interferometer and its Application to the Observation of Weak Radio Stars," Proc. Roy. Soc. A, 211, 351-375 (Mar. 6, 1952).

A new type of radio interferometer has been developed which has a number of important advantages over earlier systems. Its use enables the radiation from a weak "point" source such as a radio star to be recorded independently of the radiation of much greater intensity from an extended source. It is therefore possible to use a very much greater recorder sensitivity than with earlier methods. It is, in

addition, possible to use pre-amplifiers at the antennas, and the resolving power which may be used is therefore not restricted by attenuation in the antenna cables. Besides improved sensitivity, the new system has a number of other advantages, particularly for the accurate determination of the position of a radio source. Unlike earlier systems the accuracy of position finding is not seriously affected by rapid variations in the intensity of the radiation. It also has important applications to the measurement of the angular diameter and polarization of a weak source of radiation. The new system has been used at wavelengths of 1.4, 3.7, 6.7, and 8 meters for the detection and accurate location of radio stars, and for the investigation of the scintillation of radio stars. It has also been used in a number of special experiments on the radiation from the sun. The results obtained in these experiments have confirmed the advantages predicted analytically. (A)

K-52-04 Smith, F. G. "The Determination of the Position of a Radio Star," M. N., 112, No. 5, 497-513 (1952).

A number of new methods of using spaced-antenna interferometers to determine the position of a radio star have been devised, and their accuracies are here compared with those of methods which have already been used. The new methods are particularly applicable to the accurate determination of the positions of a small number of the most intense radio stars. The apparent position of a radio star as determined by all such methods will differ from the true position because of various refraction effects in the earth's atmosphere; the magnitude of these effects at various wavelengths is estimated. It is shown that the results may be confused by the simultaneous reception of radiation from other nearby radio stars, and the resulting error is discussed. (A)

K-52-05 Steinberg, J. L. "Les Récepteurs de Bruits Radioélectriques," Onde Électrique, 32, 445-454, summarized in French and English on pages 429 and 430 respectively, (Nov., 1952); and 519-526, summarized in French and English on pages 469 and 470 respectively, (Dec., 1952). (I. "Mesure des Températures au Moyen du Rayonnement Thermique en Hyperfréquences"; II. "Fluctuations de Gain dans les Radiomètres Emploi d'une Modulation.") [Part III published in 1953.]

After setting out the differences between receivers designed for signals and receivers designed to pick up noise (for example, as used in radio astronomy), Part I goes on to examine the conditions that lead to the highest sensitivity for the measurement of temperatures. In particular, Part I examines the relationship between the noise factor and the bandwidth, the effect of losses in the antenna system, the choice of tubes, and the choice of output measuring equipment. Part II discusses the effective level of fluctuations at the output

of a noise receiver. This level is higher than would seem to be indicated by theory, particularly in the low-frequency part of the fluctuation spectrum. An analysis is given of methods using an audio-frequency modulation intended to avoid these abnormal fluctuations. The frequency spectrum of the abnormal fluctuations is examined; it extends up to several hundreds of cycles. The experimental results are discussed. (A)

K-52-06 Vitkevich, V. V. "Measurement of the Intensity of the Radio Radiation of Cosmic Sources" [In Russian], Astronomicheskii Zhurnal, 29, 14-24 (Jan.-Feb., 1952).

The following topics are discussed in some detail: (1) the antenna temperature, (2) the compensating method of measurement and its sensitivity, (3) the modulation method and its possibilities, (4) the intensities of the radio radiation of the sun, the moon, the galaxy, and the radio stars, and (5) equipment for the reception of radio radiation of cosmic sources. (M.S.C.)

K-52-07 Vitkevich, V. V. "The Interference Method in Radio Astronomy" [In Russian], Astronomicheskii Zhurnal, 29, 450-462 (July-Aug., 1952).

The author examines various details in the principle of the interference method and outlines applications of the method to: (1) determination of the coordinates of the emitting object; (2) study of the distribution of the radio brightness of the sun; (3) study of the polarization of radio emission; and (4) observation of the occultation of a radio star by the solar corona, from which may be deduced information concerning the coronal refraction, electron density, temperature, and magnetic field. (M.S.C.)

K-52-08 Vitkevich, V. V. "An Experimental Method of Determining the Coordinates of Bursts of Radio Emission" [In Russian], Dokl. Akad. Nauk S. S. S. R., 86, No. 1, 39-42 (1952).

The two-humped shape characterizing certain non-polarized bursts of solar radio emission has been attributed to the reception of both a direct pulse and its echo reflected from the region of the corona where the refractive index is near zero. If this explanation is correct, such bursts can provide a means of investigating the corona. A proposed interference system for determining the coordinates of a burst is described and the sensitivity of the apparatus for the reception of separate short pulses is discussed. At centimeter wavelengths, the apparatus should permit the recording of pulses having durations of a second and intensities approximately 10 percent above the background solar radio emission. At meter wavelengths, the

observable intensities would be several times greater than those at centimeter wavelengths. (M.S.C.)

K-52-09 Vitkevich, V. V. "Experimental Possibilities of Observing the Monochromatic Radio Radiation of the Galaxy" [In Russian], Astronomicheskii Zhurnal, 29, 532-537 (Sept.-Oct., 1952).

A new system for the reception of the monochromatic radio radiation of the galaxy is described, and the sensitivity of the apparatus is calculated. The author's anticipations concerning the scientific value of observations of this radiation are indicated. (M.S.C.)

K-52-10 Williamson, Ralph E. "[Abstract:] Limitations in Measuring the Distribution of Galactic Radiation by Radio Telescopes," Astronomical Journal, 57, 168 (Oct., 1952).

A theoretical and computational investigation of properties of the one-dimensional form of the integral equation expressing the relationship between the power distribution as observed by a radio telescope, the antenna pattern, and the true distribution of the intensity of radio-frequency radiation indicates that: (1) the amount of information obtainable about the true distribution of intensity is seriously limited, and (2) a new, extensively tested reduction procedure is more accurate than the iterative method of analysis, and some twenty times as fast. (M.S.C.)

See also: B1-52-05 and C1-52-15.

SECTION M

MISCELLANEOUS

M. MISCELLANEOUS

M-52-01 Daniels, Fred B. "Acoustical Energy Generated by the Ocean Waves," Journal of the Acoustical Society of America, 24, 83 (Jan., 1952).

An estimate of the order of magnitude of the acoustical energy generated by ocean waves indicates that this energy is large enough to cause an appreciable heating effect at ionospheric levels, where most of it is absorbed. Using data obtained from surface measurements of the pressure amplitude, it is found that relative density changes of the order of 1 percent occur at ionospheric levels, and the suggestion is made that the "twinkling" of cosmic sources of radio waves is a result of this phenomenon. (A)

M-52-02 Daudin, Alice, and Daudin, Jean. "Sur la Variation Galactique des Rayons Cosmiques," Comptes Rendus, 234, 1551-1553 (Apr. 7, 1952).

Air showers of cosmic rays, recorded over a period of three years, show a sidereal variation corresponding to the variation of galactic radio emission and suggesting that the more energetic primaries have a galactic origin. (M.S.C.)

M-52-03 Douglas, A. Vibert. "Eighth General Assembly of the International Astronomical Union," J. R. A. S. C., 46, 217-221 (Nov.-Dec., 1952). [Material pertaining to extraterrestrial radio noise on page 220.]

This account of the Eighth General Assembly of the International Astronomical Union includes a brief summary of reports on the positions and identifications of the Cassiopeia and Cygnus radio sources and on features of solar radio emission. (M.S.C.)

M-52-04 F[lammarion], G. C. "Astronomie de Demain. Un Radio-Télescope Géant," Astronomie, 66, 190 (May, 1952).

Plans for the construction of a large radio telescope at the radio-astronomical observatory at Jodrell Bank are briefly described. The instrument will have a diameter of 250 feet and will be mounted in such a way that it can be directed to any point in the sky. (M.S.C.)

M-52-05 Ginsburg, V. L. "Interstellar Matter and Ionospheric Disturbances Causing Scintillation of Radio Stars" [In Russian], Dokl. Akad. Nauk S. S. S. R., 84, No. 2, 245-248 (1952).

It has been suggested by Ryle and Hewish (see C1-50-03) that interstellar matter undergoing gravitational attraction toward the sun is the agency responsible for initiating the ionospheric disturbances

that cause the scintillation of radio stars. The required density of the interstellar matter is calculated approximately and found to be compatible with known data. It is suggested that the hypothesis may be tested by investigation of the screening effect that would result from the interception of the stream of interstellar matter by the moon. (M.S.C.)

M-52-06 International Scientific Radio Union (Union Radio Scientifique Internationale). Proceedings ..., Vol. 9 ([Xth] General Assembly held in Sydney from August 11th to 21st, 1952), Fasc. 6, Commission V on Radio-Astronomy. Brussels, General Secretariat of U. R. S. I., 1952. 86 pages.

In addition to minutes of the sessions of Commission V held during the Xth General Assembly of the International Scientific Radio Union, this document contains reports of National Committees and of Sub-Commissions. The final section summarizes conclusions reached in regard to various proposals. (M.S.C.)

M-52-07 "IRE-URSI Fall Meeting, Cornell University, Ithaca, N. Y. — October 8-10, 1951: Summaries of Technical Papers," Proc. I. R. E., 40, 106-110 (Jan., 1952).

Brief summaries of forty-three papers are given. Those that pertain to extraterrestrial radio noise are as follows: "The World Chain of Solar Radio Observatories" by A. H. Shapley; "The NRL Fifty-foot Microwave Telescope" by F. T. Haddock; "Radiation from Hyperfine Levels of Interstellar Hydrogen" by H. I. Ewen and E. M. Purcell; "Solar Bursts and Coherent Electron Motions" by R. E. Williamson; "Space Charge Wave Amplification in Plasmas of Nonuniform Density" by H. K. Sen; "Moving Prominences and Solar Noise" by H. K. Sen; "Solar Noise Storms and Plasma Oscillations" by H. K. Sen; "The Role of Plasma Oscillations in Solar Radio Noise Bursts" by J. Feinstein; "The February, 1952 Eclipse of the Sun" by J. P. Hagen, F. T. Haddock, and W. O. Roberts; "Radio Measurements Planned for the Next Total Solar Eclipse" by F. T. Haddock and J. P. Hagen; "Radio Astronomy at Cornell University" by C. R. Burrows; "Observation of Active Regions of the Sun by Radio Interferometer and Spectroheliograph" by H. W. Dodson and Lief Owren; "An Application at 50 mc of a Theory of Radio Frequency Radiation from the Quiet Sun" by R. E. Williamson and E. E. Reinhart; "Solar Radiation at a Wavelength of 3.15 cm" by F. T. Haddock; "Outbursts of Solar Radiation Observed at 8.5 mm Wavelength" by J. P. Hagen and N. Hepburn. (M.S.C.)

M-52-08 Kulikovsky, P. "The Eighth International Astronomical Convention" [In Russian], Astronomicheskii Zhurnal, 29, 745-760 (Nov.-Dec.,

1952). [Material pertaining to extraterrestrial radio noise on pages 751 and 752.]

The author gives a detailed report of the meeting of the International Astronomical Union held in Rome in 1952. The following papers and communications on radio-astronomical subjects are among those mentioned: a report by Oort concerning Muller's study of spiral structure of the galaxy from observations at 21-centimeter wavelength, an account by Ryle of determinations of the angular diameters of the intense radio sources in Cassiopeia and Cygnus, a communication by Shklovsky concerning the Soviet research in radio astronomy, and a paper by Baade describing optical objects identified with the sources in Cassiopeia and Cygnus. Baade's description of the Cygnus source as a pair of galaxies in collision at a relative velocity of 16500 kilometers per second aroused particular interest since it contradicts the concept of radio sources as radio stars having small masses and low temperatures. (M.S.C.)

M-52-09 "Large Radio Telescope Planned," J. B. A. A., 62, 241-242 (July, 1952).

A short description of a steerable radio telescope of 250-foot aperture to be constructed at the University of Manchester's research station at Jodrell Bank is followed by a brief statement of the types of investigation for which the instrument will be used. (M.S.C.)

M-52-10 Link, F. "Éclipses Coronales des Radioétoiles." B. C. A. I. C., 3, 6-12 (Jan. 31, 1952).

The photometric theory of eclipses of the moon is applied to eclipses of radio stars by the solar corona. The possibilities of utilizing this phenomenon for exploration of the corona are discussed and the ephemeris of the eclipse of the radio star 05.01 in Taurus is given. (A)

M-52-11 Mitra, A. P. "Study of the Ionosphere by Extraterrestrial Radio Waves," Indian Journal of Physics, 26 (and Proceedings of the Indian Association for the Cultivation of Science, 35), 495-511 (Oct., 1952).

The paper presents a connected account of a novel method of studying the ionosphere in which the radio-frequency radiations from extraterrestrial sources may be utilized. Four different types of measurements on such waves are discussed for this purpose, namely (1) ionospheric refraction, (2) ionospheric attenuation, (3) twinkling of radio stars, and (4) effects of sudden ionospheric disturbances

(SID's). The available experimental results are compared with ionospheric theory and further lines of investigation which might profitably be followed are indicated. (A)

M-52-12 "New Radio-Telescope for the University of Manchester" (Section of "News and Views"), Nature, 169, 736 (May 3, 1952).

Announcement is made of the decision of the Department of Scientific and Industrial Research and the Nuffield Foundation to provide the Jodrell Bank Experimental Station with a steerable paraboloidal radio telescope of 250-foot diameter. (M.S.C.)

M-52-13 Pomerantz, M. A., and McClure, G. W. "[Abstract:] On the Enhanced Primary Cosmic-Ray Intensity Associated with Solar Disturbances," Phys. Rev., 87, 240 (July 1, 1952).

Bursts of primary cosmic-ray intensity, recorded during balloon flights at times when active regions were present on the sun, sometimes appeared to be correlated with the characteristics of the 200-megacycle radiation. (M.S.C.)

M-52-14 Ri[ghini], G. "Radioastronomia" (Section of "L'Ottava Assemblea dell'Unione Astronomica Internazionale in Roma" by G. Ri. and others), Coelum, 20, 167-169 (Nov.-Dec., 1952).

A summary of the radio-astronomical discussions that formed a part of the program of the Eighth General Assembly of the International Astronomical Union is followed by a short account of the Volta Conference on "Problems of Solar Physics." Among the specific topics mentioned are: the new status of radio astronomy as an important field of investigation, the need for determining a "radio-electric Wolf number," the establishment of a chain of radio observatories to patrol the sun's activity, the relation between solar flares and solar radio emission, preliminary results of observations made during the solar eclipse of February 25, 1952, improved equipment for resolving point sources of radio emission, the increased number of known radio stars, problems concerning the nomenclature of radio stars, new identifications of the Cygnus and Cassiopeia radio stars with objects observed optically, the emission line of interstellar hydrogen in the radio spectrum, new information concerning the solar temperature, solar magnetic phenomena, the diameter and form of the sun as observed at radio wavelengths, and the observation of the occultation of a radio star by the solar corona. (M S.C.)

M-52-15 Simpson, J. A., Fonger, W., and Wilcox, L. "A Solar Component of the Primary Cosmic Radiation," Phys. Rev., 85, 366-368 (Jan. 15,

1952).

Observations of the intensity of the nucleonic component of the low-energy primary cosmic radiation show a recurrent series of maxima having a period of approximately 27 days. The maxima occur at the times when active regions of the sun (defined as regions producing intense coronal emission, flares, and enhanced radio noise and bursts) are very close to the sun's central meridian. There exists in addition an approximate correlation between the magnitude of solar activity and the observed changes of particle intensity. As an illustrative example, the neutron intensities obtained at three stations are graphically compared with intensities of solar radiation at 2800 Mc./s. for the period July 1 to September 30, 1951. (M.S.C.)

M-52-16 Simpson, J. A., Fonger, W., and Wilcox, L. "[Abstract:] Experiments on the Solar-Produced Component of the Cosmic Radiations," Phys. Rev., 85, 720 (Feb. 15, 1952).

Time-dependent changes of the primary cosmic-ray radiations in the low- and intermediate-energy range show 27-day periodic recurrences associated with large disturbed regions on the sun. The regions are identified by occurrences of solar radio noise bursts and visual flare effects. [See also M-52-15.] (M.S.C.)

R. SURVEYS

R-52-01 Atanasijević, Ivan. "L'Émission Radioélectrique de la Nébuleuse d'Andromède," Astronomie, 66, 133-135 (Apr., 1952).

The work of Hanbury-Brown and Hazard in identifying and investigating the radio emission from the Andromeda Nebula is described. The probable detectability of radio emission from other external galaxies, suggested by the observations of Ryle, Smith, and Elsmore, is briefly discussed. (M.S.C.)

R-52-02 Behr, A., and Siedentopf, H. "Sonnenüberwachung," Naturwissenschaften, 39, No. 2, 28-38 (Jan., 1952).

The types of phenomena that occur on the sun, as revealed by direct observations, are described. A short summary of some of the characteristics of solar radiation at radio frequencies is included. Publications devoted wholly or in part to systematic presentations of solar data are outlined. (M.S.C.)

R-52-03 Bouška, Jiří. "Radio Astronomy" [In Czech], Vesmír, 31, 9-12 (Jan., 1952).

The author summarizes the information that has been obtained by radio-astronomical methods of investigation, especially as it pertains to the sun and to meteors. (M.S.C.)

R-52-04 Cabannes, J. "Les Progrès Récents de l'Astronomie," Astronomie, 66, 295-302 (July-Aug., 1952).

Successive developments in the investigation of galactic radio emission and solar radio emission, beginning with the original discoveries, are summarized, and some of the unsolved problems in radio astronomy are briefly discussed. The importance of the detection of interstellar hydrogen by means of its spectrum line at 21-centimeter wavelength is cited. Observations, both by optical and radio techniques, made at the eclipse of February 25, 1952, are briefly described. (M.S.C.)

R-52-05 "Cavendish Laboratory" (Section of "Proceedings of Observatories"), M. N., 112, No. 3, 298-300 (1952).

Results of recent radio-astronomical investigations at the Cavendish Laboratory are briefly described under the headings, "Solar Work," "Galactic Observations," and "Refraction Effects in the Terrestrial Atmosphere." New interferometer observations of the sun at wavelengths of 1.4 and 7.9 meters, together with earlier measurements at

other wavelengths, show that the sun's effective diameter increases progressively with wavelength. (M.S.C.)

R-52-06 Coutrez, R. "Applications Récentes de l'Électronique à l'Astronomie," Ciel et Terre, 68 (and Bulletin de la Société Belge d'Astronomie, de Météorologie et de Physique du Globe, 57), 73-88 (Mar.-Apr., 1952). Reprinted as Communications de l'Observatoire Royal de Belgique, No. 41.

The second half of this paper is devoted to the subject "Radio Astronomy and Radio Telescopes." The scope and significance of radio-astronomical investigations are outlined. The technique of detecting radio emission from celestial sources is discussed and the parts of a radio telescope are described. Pictures of two radio telescopes, one being constructed in Belgium, the other erected in the Belgian Congo, are included. (M.S.C.)

R-52-07 Institute of Radio Engineers. "Radio Astronomy" (Subsection of "Radio Progress During 1951"), Proc. I. R. E., 40, 426-427 (Apr., 1952).

The latest advances in radio astronomy are briefly summarized under the headings, "Solar Radio Waves" and "Galactic Radio Waves." Numerous references are cited. (M.S.C.)

R-52-08 "Jodrell Bank Experimental Station, University of Manchester" (Section of "Proceedings of Observatories"), M. N., 112, No. 3, 302-305 (1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 65.

Developments in radio-astronomical research at the Jodrell Bank Experimental Station during 1951 are briefly reported. The following topics pertaining to various aspects of extraterrestrial radio noise are among those included: "Radio-Frequency Emissions from Extra-galactic Nebulae," "Radio-Frequency Emissions from the Galaxy," "Scintillation of the Radio Stars," and "Solar Radio-Frequency Emissions." (M.S.C.)

R-52-09 Klinger, Hans Herbert. "Solare und Kosmische Radiowellen," Experientia, 8, 325-336 (Sept. 15, 1952).

A short summary is given of the more important results and problems of research in radio astronomy. The solar radio-frequency radiation can be traced back to three different components: a constant thermal radiation, a radiation emitted by the sunspots, and an eruptive component. Cosmic radio waves are, according to the present state

of our knowledge, mainly sent out in the intra-galactic space from the radio stars whose nature is still unknown. A lesser part of the cosmic radio-frequency radiation is emitted from extragalactic star systems, and a quite small component, which is practically without significance, arises from the interstellar gas. Attention is drawn to possible connections between the cosmic radio waves and cosmic corpuscular radiation, and in conclusion the relationship between cosmic and solar radio waves and other branches of science is discussed. (A)

R-52-10 Lovell, A. C. B. "The Radio Astronomer's Universe," Advancement of Science, 8, 351-360 (Mar., 1952). Reprinted as Astron. Contrib. U. Man. II, Jodrell Bank Reprint, No. 66.

The author's Norman Lockyer Lecture given in Belfast on November 28, 1951, is presented. It traces the development of the concept of the universe revealed by observations of radio radiation, and compares the radio astronomer's universe with that of the astronomer. A considerable part of the discussion is devoted to the solved and unsolved problems concerning radio stars. (M.S.C.)

R-52-11 Lovell, Bernard, and Clegg, J. A. Radio Astronomy. New York, John Wiley & Sons, Inc., 1952. 238 pages. Also published in London by Chapman & Hall, Ltd.

This book presents a fully illustrated account of the information that has been obtained through the use of radio techniques in astronomical investigations. The first four chapters provide an introduction both to elementary concepts in astronomy and to the basic radio techniques that are employed. Of the remaining eighteen chapters, seven are primarily concerned with radio emission that originates in extraterrestrial sources. They bear the following titles: "The Discovery of Radio Waves from the Sun"; "Solar Disturbances and Radio Emissions from Sunspots"; "Theories of the Origin of Solar Radio Emissions"; "Radio Waves from the Galaxy"; "The Distribution of Galactic Radio Noise"; "The Origin of the Galactic Radio Emissions"; and "The Twinkling of the Radio Stars." The radio emission associated with solar flares is discussed in a chapter entitled "Solar Flares and their Terrestrial Effects" and a section on "Radio Noise from the Moon and the Measurement of Lunar Temperatures" is included in a chapter on "Radio Investigations of the Moon." [See page 77.]
(M.S.C.)

R-52-12 Lüst, Reimar. "Linienemission der Interstellaren Materie im Radiofrequenzbereich," Naturwissenschaften, 39, No. 16, 372-374 (Aug., 1952).

The status of knowledge concerning the continuous radio emission

of the galaxy, of point sources, and of extragalactic nebulae is briefly summarized. A description of the energy-level scheme of the hydrogen atom follows, and the first results of measurements of the emission line of interstellar hydrogen at a wavelength of 21.2 centimeters are reviewed. The significance of the observation of this line in the spectrum of the interstellar medium is briefly discussed. (M.S.C.)

R-52-13 Ovenden, Michael W. "The Problem of the Origin of the Galactic and Discrete-Source Radio Emissions" (Astronomy Section of "Recent Advances in Science"), Science Progress, 40, 78-84 (Jan., 1952).

The various hypotheses that have been advanced in attempts to explain the origin of the radio emission from the galaxy and the discrete sources are summarized, and their relative merits are discussed in the light of the observational evidence. (M.S.C.)

R-52-14 "Radio Astronomy," Engineer, 193, 640-642 (May 9, 1952).

The development of radio astronomy is surveyed in connection with the announcement of plans for the construction of a large steerable radio telescope at Jodrell Bank. Emphasis is placed on the aspects of radio astronomy pertaining to radiation from sources outside the solar system, these being chosen to comprise the main program of investigation for the new instrument. (M.S.C.)

R-52-15 "Radiophysics Laboratory, Sydney" (Section of "Proceedings of Observatories"), M. N., 112, No. 3, 325-327 (1952).

Recent investigations at the Radiophysics Laboratory on various aspects of cosmic and solar radio waves are briefly described. New instruments being developed include equipment to resolve the smaller discrete radio sources and equipment to extend the observable range of dynamic spectra of solar bursts to about 40-320 Mc./s. Preliminary directional observations of 20-centimeter radiation from the sun are being made with an array of thirty-two parabolic antennas of six-foot diameter. (M.S.C.)

R-52-16 "Radiostraling uit de Wereldruimte. Symposium, Georganiseerd door de Nederlandse Astronomenclub, de Nederlandse Natuurkundige Vereniging en de Stichting 'Radiostraling van Zon en Melkweg' op 1 November 1951 te Utrecht," Nederlands Tijdschrift voor Natuurkunde, 18, 115-134 (May, 1952) and 137-154 (June, 1952). (Oort, J. H. "Inleiding," 116-118; Muller, C. A. "Waarnemingsmethoden," 119-126; Stumpers, F. L. "Theoretische Grenzen van de Ontvangstgevoeligheid,"

127-129; Houtgast, J. "Radiostraling van de Rustige Zon," 130-134; Minnaert, M. G. J. "De Radiostraling van de Gestoorde Zon," 137-141; de Voogt, A. H. "Verband Tussen Radio-verschijnselen van de Zon en de Aardse Ionosfeer," 142-144; van de Hulst, H. C. "De Continue Straling van het Melkwegstelsel," 145-150; Oort, J. H. "De Monochromatische Emissie van de Interstellaire Waterstof," 151-154.)

This report of the proceedings of a symposium held on November 1, 1951, at Utrecht presents a review and evaluation of the status of research on radio radiation from celestial sources. The following subjects are covered: methods of observation, theoretical limits of receiver sensitivity, radio radiation from the quiet and disturbed sun, the relationship between the radio phenomena of the sun and the ionosphere, the continuous radiation of the Milky Way system, and the monochromatic emission of interstellar hydrogen. Reports of discussions following individual contributions are included. (M.S.C.)

R-52-17 Ratcliffe, J. A. "Radio Astronomy," Nature, 169, 348-350 (Mar. 1, 1952).

The substance of a Friday Evening Discourse at the Royal Institution is presented. Brief introductory remarks concerning the reception of weak noise signals are followed by a description of the types of instruments used for radio observations of astronomical sources. The principal observational results concerning the radio stars, the general background of radio emission from the galaxy, and the radio emission from the sun are summarized, and the status of attempts to interpret them theoretically is explained. (M.S.C.)

R-52-18 Ryle, M., and Ratcliffe, J. A. "Radio-Astronomy," Endeavour, 11, 117-125 (July, 1952).

The problem of observing the radio radiation from astronomical sources is discussed and instruments used for this purpose are described. Some of the known facts and theories concerning the radio emission of the galaxy, the radio stars, and the sun are summarized. (M.S.C.)

R-52-19 Salomonovich, A. "Radio Astronomy" [In Russian], Radio, No. 8, 22-26 (Aug., 1952).

The status of investigations concerning radio radiation from extraterrestrial sources is described, with emphasis on the types of radio telescopes and interferometers used for detecting this radiation. (M.S.C.)

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R-52-20 Shklovsky, I. S. "Radio Stars" [In Russian], Priroda, 41, No. 2, 26-35 (Feb., 1952).

A brief history of the early investigations of galactic radio radiation is followed by an account of the known characteristics of radio stars and the use of interferometers for observing them. The numerous suggestions that have been advanced in attempts to clarify the nature of the radio stars are reviewed and discussed. (M.S.C.)

R-52-21 "Solar Radio Noise Bursts," Technical News Bulletin (U. S. National Bureau of Standards), 36, 65-67 (May, 1952).

This short account describes investigations at the National Bureau of Standards concerning the theoretical interpretation of bursts of solar radio noise by the mechanism of plasma oscillations. (M.S.C.)

R-52-22 Struve, Otto. "Galactic Exploration by Radio," Sky and Telescope, 11, 214-217 (July, 1952).

The author gives a general, illustrated account of the investigation of the structure of the galaxy by observation of the radiation from interstellar hydrogen at a wavelength of 21 centimeters. He discusses the meaning of hyperfine structure, summarizes the pertinent observational results already obtained, and explains the method and usefulness of the analysis of the Doppler displacement of the 21-centimeter emission line. (M.S.C.)

SECTION 8

BOOK REVIEWS

S. BOOK REVIEWS

Reviews of: Lovell, Bernard, and Clegg, J. A. Radio Astronomy. New York, John Wiley & Sons, Inc., 1952. 238 pages. Also published in London by Chapman & Hall, Ltd. [Listed as B-52-11, page 71.]

S-52-01 C., A. C. Journal of the British Interplanetary Society, 11, 140 (May, 1952).

S-52-02 C., W. T. Wireless Engineer, 29, 170 (June, 1952).

S-52-03 D., D. W. J. B. A. A., 62, 294-295 (Oct., 1952).

S-52-04 Forrest, J. S. British Journal of Applied Physics, 3, 271 (Aug., 1952).

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